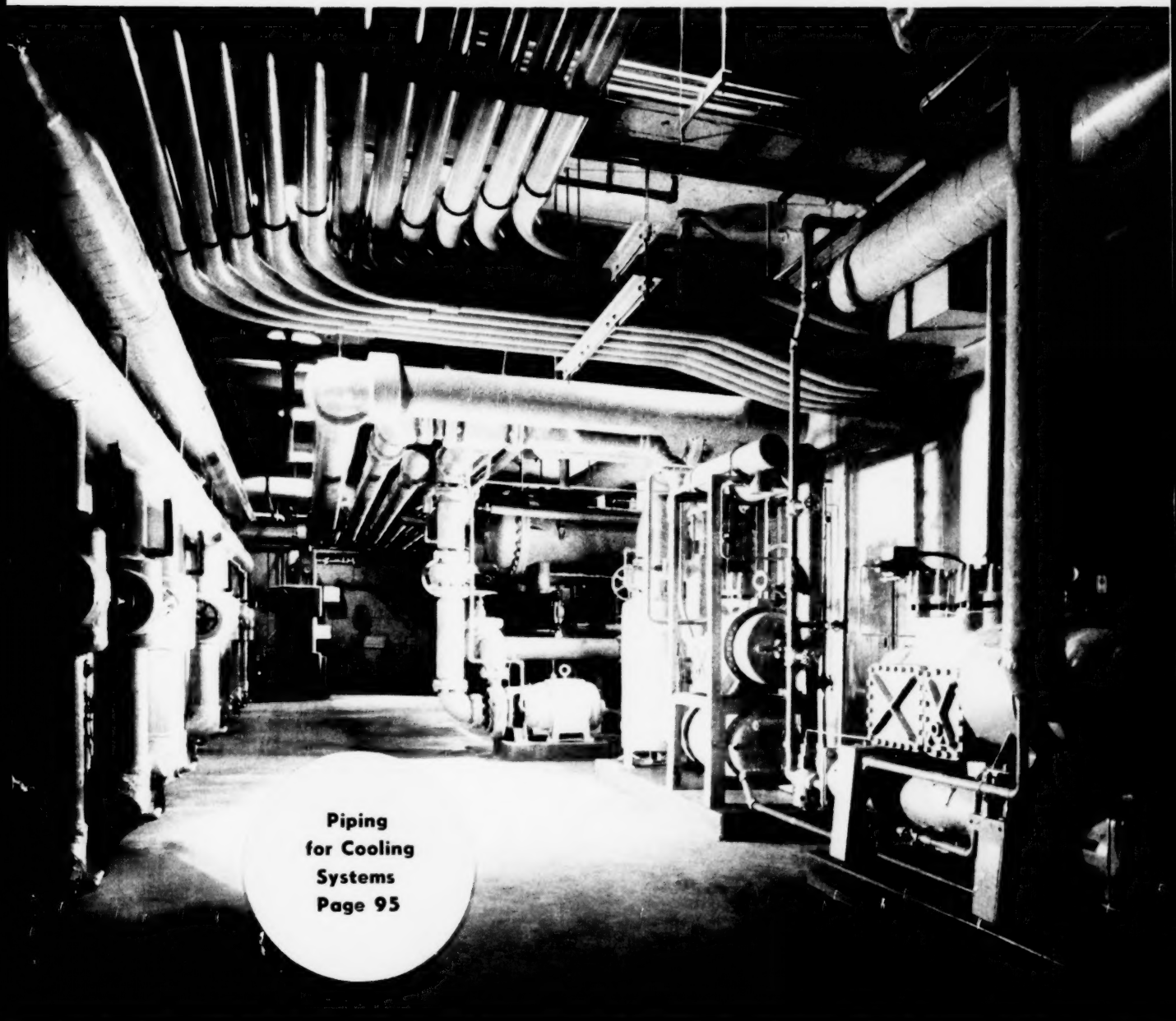
MARCH, 1953

HEATING AND VENTILATING

INCLUDING AIR CONDITIONING – PIPING – REFRIGERATION – AIR SANITATION



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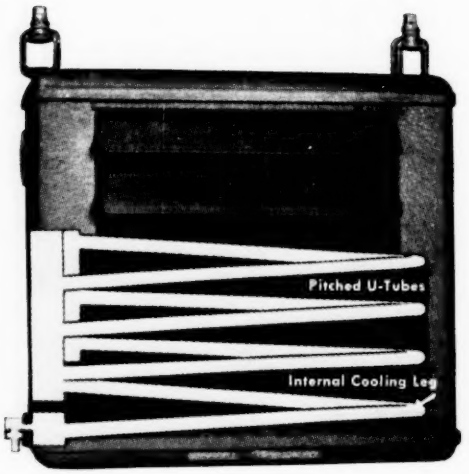
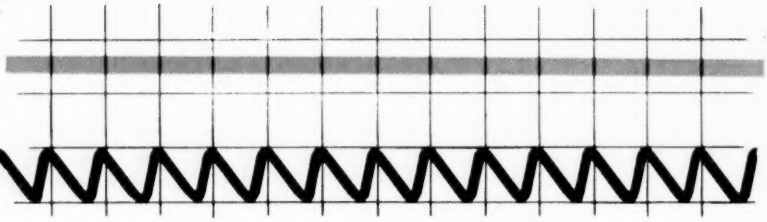


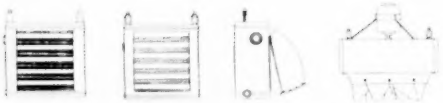
when buying unit heaters

be sure you get this

...not this!



With **THERMOLIER**...
the Grinnell Unit Heater . . . you get
CONTINUOUS RATED CAPACITY



Horizontal Delivery | Textile Model | Velocity Nozzle | Vertical Delivery

THERMOLIER FEATURES

INTERNAL COOLING LEG A Grinnell feature which permits the use of a plain thermostatic trap for draining condensate.

PITCHED U-TUBES Built-in pitch of U-tubes provides complete drainage of condensate and elimination of destructive water hammer.

CONTINUOUS RATED CAPACITY The combination of Thermolier's internal cooling leg and the built-in pitch of tubes assures continuous rated capacity.

BUILT-IN EXPANSION PROVISIONS Every tube is an expansion bend of the U type to allow for independent expansion and contraction of each tube.

TUBE-TO-HEADER CONSTRUCTION Safety and durability assured by unique tube-to-header construction.

EASE OF ERECTION Exclusive with Thermolier are the adjustable swivel couplings which provide an easy, cost-saving method of hanging the unit.

SIMPLE PIPE CONNECTIONS The supply and return piping connections are on the same side to assure compactness, neatness and economy in installation.

MOTORS Thermolier motors are built specifically for unit heater duty. They give maximum operating efficiency with minimum power cost.

The practical advantages of unit heating, of course, are well known. But in order to get *maximum* economy and efficiency, certain engineering and structural features *must be* present in the unit heater of your choice.

Take provisions for draining off condensate. Failure to provide freedom from collected condensate in the heating element can interfere with heat output and adversely affect capacity.

A Thermolier Unit Heater successfully handles this drainage problem with its pitched U-tubes and internal cooling leg, through which all the condensate passes. In fact, condensate cooling is so efficient with Grinnell Thermoliers that a thermostatic trap — the simplest and least expensive of all traps — can be used with every model. Condensate temperature is lowered to the point where the trap is always draining — giving Thermolier Unit Heaters their *continuous rated capacity.*

Check Thermolier's advantages at left. For more details, call your local Grinnell distributor — or send for catalog.

GRINNELL

THERMOLIER UNIT HEATERS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

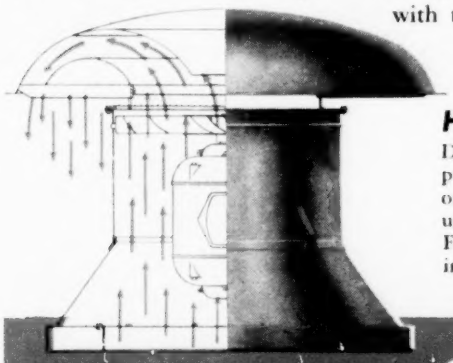
Manufacturer of: pipe fittings • welding fittings • forged steel flanges • steel nipples • engineered pipe hangers and supports
Thermolier unit heaters • Grinnell-Saunders diaphragm valves • prefabricated piping • Grinnell automatic fire protection systems

(Photo courtesy of National Biscuit Company)

Smart Cookies LIKE NABISCO CALL FOR Controlled Ventilation

At Portland, Oregon, the modern National Biscuit Company plant is one of the most scientifically equipped food producing establishments in the world. But you can imagine how hot it could get around ovens that turn out several million cookies a day! Plant designers Ford, Bacon and Davis anticipated the need for exhausting hot air caused by baking processes, and came up with the right recipe. 42 DeBothezat Power-Flow Roof Ventilators, each with 21" fan wheel and 1 HP totally enclosed air-over motor, were installed over the oven area. 19 Power-Flows with 27" fan wheel and 1 HP motor were installed above the packaging and shipping areas. Altogether these 61 Power-Flow Roof Ventilators exhaust more than 445,000 cubic feet of air per minute. Controlled ventilation assures good working conditions, and is in keeping with the high standards of NABISCO operation and sanitation.

Certified Ratings



HOW ABOUT YOUR PLANT?

DeBothezat Power-Flow Roof Ventilator is a motor-driven fan in a weatherproof housing, for use with or without duct systems, either for air exhaust or intake. Available with fan wheels 12" through 48" in diameter, delivering up to 40,900 CFM. Low, streamlined design blends well with all architecture. For catalog containing illustrations, specifications and certified capacity ratings, write our factory, Dept. HV-353, or phone your local DeBothezat agent.

Power-Flow ROOF VENTILATORS

Built by **DeBothezat Fans**

Division of American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS

Lafayette Elementary School, Waterloo, N. Y. Completed 1951 at a cost of $550,000. Architect and Engineer: Carl C. Ade. Heating Contractor: A. Burgat, Inc.

COLD MEETS ITS WATERLOO

In Waterloo, New York

New York Community Modernizes its School System With New Schools and Tru-Perimeter Heating

When Waterloo, N. Y., decided its educational shoe was pinching they called on Carl C. Ade, prominent Rochester architect and engineer, to help remedy the situation.

Result — the handsome new Lafayette Elementary School illustrated here and the even larger Skoi-Yase (Indian for 'bubbling water') Elementary School now under construction. With these new schools, and its existing buildings, Waterloo has solved its educational space problems for many years to come.

For efficient, modern heating, both these new schools use Webster Walvector, as do many of the schools designed by Carl C. Ade's office.

Here is Tru-Perimeter Heating. The cold perimeter walls of the buildings are heated gently and evenly. There are no cold spots, no hot spots, no drafts. With Webster Walvector, the heating element and piping are concealed in attractive metal enclosures.

Webster Walvector in perimeter heating simplifies piping, uses fewer risers. Heating up is quick, effectively controlled. Buildings can be heated just before occupancy and the heat reduced immediately after the need is gone.

Whether you are contemplating new construction or modernization, look into the advantages of Webster Walvector. For complete information call the Webster Representative or write us

Address Dept. HV-3

WARREN WEBSTER & COMPANY

Camden 5, N. J., Representatives in Principal U. S. Cities

In Canada, Darling Brothers, Limited, Montreal

Webster WALVECTOR

REG. U. S. PAT. OFF.

For Steam or Hot Water Heating

Recent New York State Schools by Carl C. Ade that use Webster Walvector

Elementary School, Fulton;
Britton Road School, Greece;
Irondequoit Jr.-Sr. High School
District #3, Irondequoit;
Pittsford Jr.-Sr. High School, Pittsford;
Griffith Institute, Springville;
Bryant School, Hornell;
Lafayette School, Waterloo;
Skoi-Yase School and Bus Garage, Waterloo;
Webster Central School, Webster;
West Webster Elementary School, West Webster

Above: Kindergarten of the Lafayette School. Here concealed Webster System Radiators deliver heat through top outlet grilles shown in window sills. Air enters below toy shelving.

Left: Webster Walvector under windows in Lafayette School classroom. Air enters below Walvector enclosure, is gently warmed by heating element and passes out through the attractive grilles. Wall-to-wall warmth, no cold spots.

HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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Also Publishers of
HEATING & PLUMBING EQUIPMENT NEWS
and technical books.

THIS MONTH'S COVER

Two Westinghouse refrigeration compressors used in cooling systems for fur storage and drinking water at vaults of I. Magnim, San Francisco. Piping for refrigeration and air conditioning systems is discussed beginning page 95.

Washington News

LORING F. OVERMAN

FOR such a short month, February caused quite a stir in Washington.

Off came the wage and salary controls which have puzzled management and irked labor for some time.

In anticipation of the expiration of the Controlled Materials Plan on June 30, the CMP system was open ended to permit suppliers of steel, copper and aluminum to accept unrated orders after first taking care of those who hold ratings.

And to permit orderly freeing of prices by April 30, when the authority for price controls expires, several decontrol packages released thousands of items which have been under ceiling since January 26, 1951. Some questioned the orderliness of the packaged procedure, because of certain inconsistencies, but OPS officials promised that everything would be straightened out by the packages planned for decontrol during the weeks preceding April 30.

Oil On, Coal Off

For example, heating folks found it a little difficult to see why the list on February 12 decontrolled (among other things) all petroleum products other than No. 2 heating oils, while on February 18 price controls were removed from all solid fuels—coal, coal briquets, petroleum briquets, coke, and packaged fuel.

In a similar action, thousands of consumer durables were removed from price controls, while items of similar function but industrial in classification, remained frozen. Room-size air conditioners and dehumidifiers, for example, were on the freed list on the first go-round, but not commercial refrigeration. Decontrol action in the Consumers' durable field is accomplished by two regulations—General Overriding Regulation 4, Revision 1, Amendment 13, and General Overriding Regulation 5, Revision 1, Amendment 16.

Another regulation—General Overriding Regulation 9, Amendment 41—does odd things to a list of industrial materials and manufactured goods. For example, heating, lighting, ventilation, and air conditioning equipment, industrial and laboratory furnaces and ovens are decontrolled, but not space heaters, warm air furnaces, or coke ovens.

Decontrolled in the same package are "Fans and blowers, industrial, including warm air furnace fans, attic ventilating fans, built-in fans over 24 inches in diameter and pressure fans and blowers but excluding unit heaters or unit ventilators, hand blowers, pedestal, portable, ceiling, wall-bracket type fans, and propeller type fans 24 inches and under in diameter."

In other words, the present decontrol packages are not blanket orders, after all. Instead, they include exceptions reflecting administrative procedure, and the manufacturer or distributor affected must proceed with extreme caution. In announcing the various decontrol actions, OPS also warns that records of transaction during the base period and freeze period must be kept ready for inspection for the period prescribed by the applicable ceiling price regulations.

Also of interest to heating and ventilating contractors is General Overriding Regulation 14, Amendment 40 which decontrolled specified service charges in consumer and commercial-industrial-government fields. Particularly applicable is the provision eliminating "price controls on services supplied to commercial, industrial or government users except where the services are used directly in processing or manufacturing commodities still under price control."

Stop, Look, Listen

Late in February, price control officials were keeping the remaining decontrol packages under wraps to prevent leaks. It was expected that four or five more General Overriding Regulations would release all controlled items by April 30. Last items to be freed, it seemed likely, would be basic metals. OPS will want to keep some items under controls in the hope that a last-minute change of mind might require a renewal of the controls program. In such a case, the OPS folks who remain would be in an admirable spot to grab the ball and run for good jobs.

Although it seems most unlikely that there could be an about face on the decontrol subject, several members of Congress seem rather insistent that the President be given stand-by powers to recontrol prices, wages and materials quickly in case of emergency. Although indicating at first that he saw no need for such power, President Eisenhower is not unalterably opposed to such an idea.

Meanwhile, Senator Capehart has introduced a standby bill in the Senate and has scheduled hearings. And in the House, Representative Multer (D-NY) offered a bill to empower the President to put a 90-day freeze on wages and prices under emergency conditions. Such a freeze, Rep. Multer explains, would give Congress time to consider what other steps might be necessary. During the 90-day period Congress could extend the status quo for any length of time.

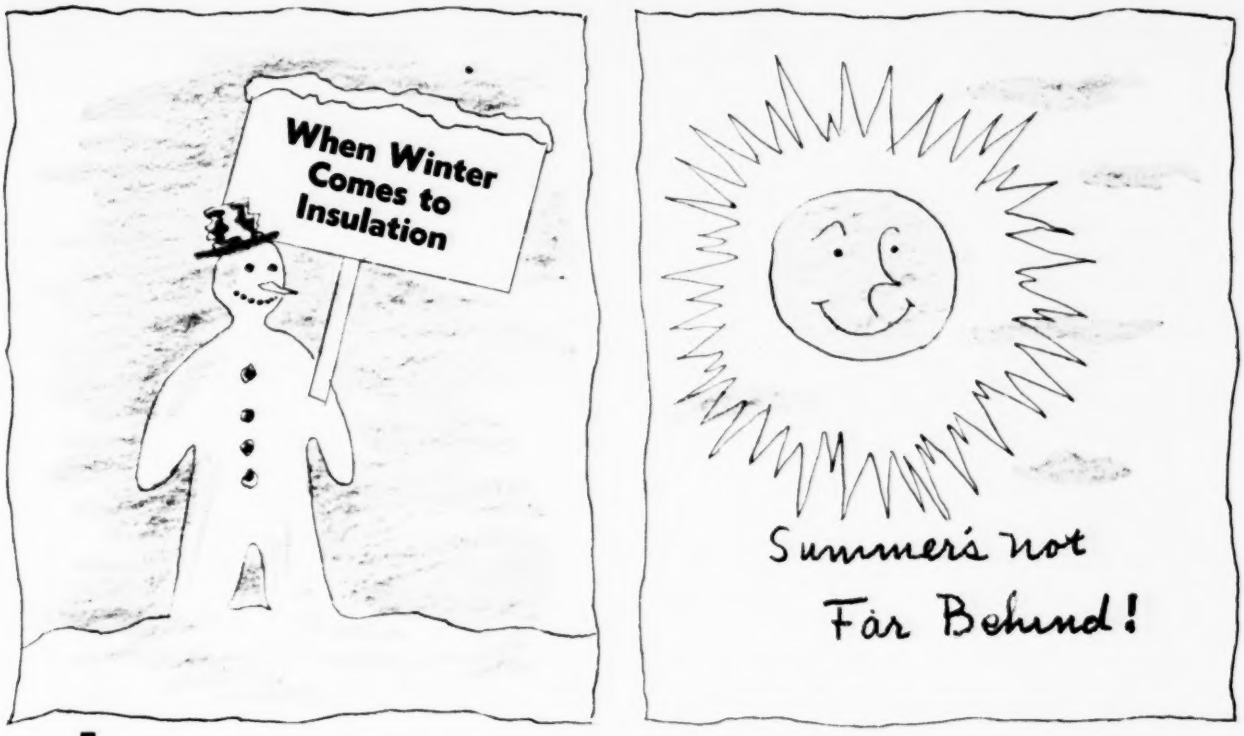
CMP Clarification Needed

The announcement that the Controlled Material Plan of allocating scarce materials will expire as per legislation on June 30, leaves a number of matters in a condition requiring further explanation. Although the CMP plan will not be used to distribute steel, copper and aluminum, Washington defense planners seem rather certain that some authority will be worked out to channel those items into the military as needed.

Manufacturers of class B products have already been informed not to file CMP-4B applications for materials needed in the third and fourth quarters, and there is some question as to the status of allocations already made on long lead-time items, involving third and fourth quarter deliveries.

Why Overseas Friends?

Some very striking reasons why it is important for the United States to have friends overseas, were stated by the Office of Defense Mobilization in a report of our need for supplies of dozens of strategic raw materials.



Insulation for winter warmth and fuel conservation can be more efficient and also provide coolness and comfort in summer. It can reduce original and operating costs of air cooling equipment as well as of heating plants. A building really shielded from the summer sun's radiation is considerably cooler, not only by day but also at night. A building properly shielded from winter heat loss heats up faster, is more comfortable, requires less fuel, and stays warm longer at night when furnaces are turned down.

Choosing insulation can be a thoughtless, perfunctory product of inertia or a scientific selection based on physical needs, financial considerations and performance. Readily available studies and tables show the thermal factors, permanency, and permeability to water vapor of different materials, and to what extent they foster or prevent destructive condensation.

Gold, silver and aluminum sheets have the best ratings in all these categories. But aluminum may be had at a very low cost in the form of pre-fabricated multiple accordion sheets which automatically create reflective air surfaces and spaces when installed.

Multiple accordion aluminum has high rejection and low projection of heat rays; low conduction because of preponderant air spaces and slight mass. It blocks convection because of compartmented layers. To vapor, it has zero permeability. It is practically non-condensation-forming. Slight mass also prevents unwanted heat storage.

Commercially, multiple accordion aluminum is available as Infra Insulation, Types 6, 4 and 4 Jr. Cost of Type 6, material with labor, in new construction between wood joists, is about 9¢ a sq. ft.

Read the detailed development of the points made above, consult the charts of thermal factors and of relative reflectivities and emissivities; benefit from pertinent, valuable information in Schwartz's "Simplified Physics of Vapor and Thermal Insulation." Use the coupon to get a FREE COPY.

INFRA THERMAL FACTORS. TYPE 6

Up-Heat	**C.089, R 11.23**	**= 4 3/5"**	**dry rockwool**
Wall-Heat	**C.073, R 13.69**	**= 5 5/8"**	**dry rockwool**
Down-Heat	**C.044, R 22.72**	**= 9"**	**dry rockwool**

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"The idea of American self-sufficiency has always been to a considerable extent a myth," observes the report. "The magnitude is shown clearly in the case of metals—the base for any industrial civilization. We are, in part at least, dependent on foreign sources for every metal which we use except for magnesium and molybdenum."

In the following list of materials—many of them important to the heating, ventilating, air conditioning and plumbing industries—the figures indicate the percentage of our dependency upon other countries:

Antimony, 75% dependency; Bolivia, Mexico, South Africa.

Asbestos, 95%, Canada, South Africa, Bolivia. Amosite grade, for thermal insulation, in very short supply; crocodilite, for gas mask filters, reserved entirely for the military; crystolite, essential for covering electric cable, inadequate.

Bauxite, 65% dependency, Dutch Guiana, British Guiana, Indonesia; supply adequate.

Beryl, 90%, South Africa, Brazil, Southern Rhodesia; supply tight.

Bismuth, 50 to 55%, Peru, Mexico, Canada and Yugoslavia; adequate.

Chromite, 99%, South Africa, Turkey, Philippines, Southern Rhodesia; requirements exceed supply.

Cobalt, 90%, Belgian Congo, French Morocco, Canada, Brazil and others; supply expendable.

Columbium, 100%, Nigeria, Belgian Congo, Brazil. Outlook for new sources not favorable.

Industrial diamonds, 100%, principal supplier, Africa.

Jewel bearings, 90%, Switzerland supplies 99% of our imports. Supply adequate for present needs.

Lead, 45%, Mexico, Canada, Peru, Yugoslavia; supply favorable.

Manganese, 90%, India, South Africa, Cuba, Mexico and others. Total supply inadequate.

Mercury, 90%, Spain, Italy, Yugoslavia, Mexico. Supplies adequate.

Mica, 95%, India, Brazil, Madagascar, Canada. Supply barely meets demand.

Nickel, 99%, four-fifths of world's supply from Canada. Supply critical.

Platinum group, 90%, Canada, Colombia, South Africa. Supply balances demand.

Quartz crystals, 100% dependency, Brazil produces 99% of world output. Supply adequate.

Natural rubber, 100% dependency, Malaya, Indonesia, Thailand. Synthetics ease shortage.

Tin, 100% dependency, Southeast Asia, Belgian Congo, Thailand and Nigeria. Demand exceeds supply.

Tungsten, 52% dependency, major imports from Bolivia, Portugal, Spain and Brazil, Australia and several others. Before 1950, China was our major source. Canadian production soon to reach important levels.

Zinc, 35%, Canada and Mexico principal sources; also Peru, Bolivia, Spain and others. Supply adequate.

Washington Miscellany

To Study Government Competition. Creation of a 21-member commission to investigate government competition with private business is proposed in new legislation introduced in Congress by Representative Fred E. Busbey, Illinois Republican. Representative Busbey said there are now more than 80 federal agencies competing directly with tax-paying private enterprises. More than $12.5 billion in federal funds is invested in the 40 agencies which he says carry on lending and credit activities. He pointed out that publicly owned hydroelectric power plants have increased almost six times in the last 20 years. The $50 billion invested amounts to more than twice the sum invested in all privately-owned companies.

Congress also feels that public housing constitutes unfair competition, since conditions prevailing when the housing act was passed no longer exist. Democrats may be expected to publicize Congressman Busbey's statement as further evidence that "we've never had it so good." Not so Mr. Busbey, who contends that "the enormous growth of government in the last 20 years is a dangerous threat to the sovereign rights of the individual states and to the personal liberty of all of us."

Consumer May Get Break. In both the House and the Senate, bills have been introduced proposing formation of a Select Committee on Consumer Interests. An identical bill was reported favorably by the Senate Rules Committee last June, but never reached the floor for a vote. Senator Guy N. Gillettee (D-Iowa), one of the sponsors, points out that consumers are insisting on more adequate representation in the legislative process.

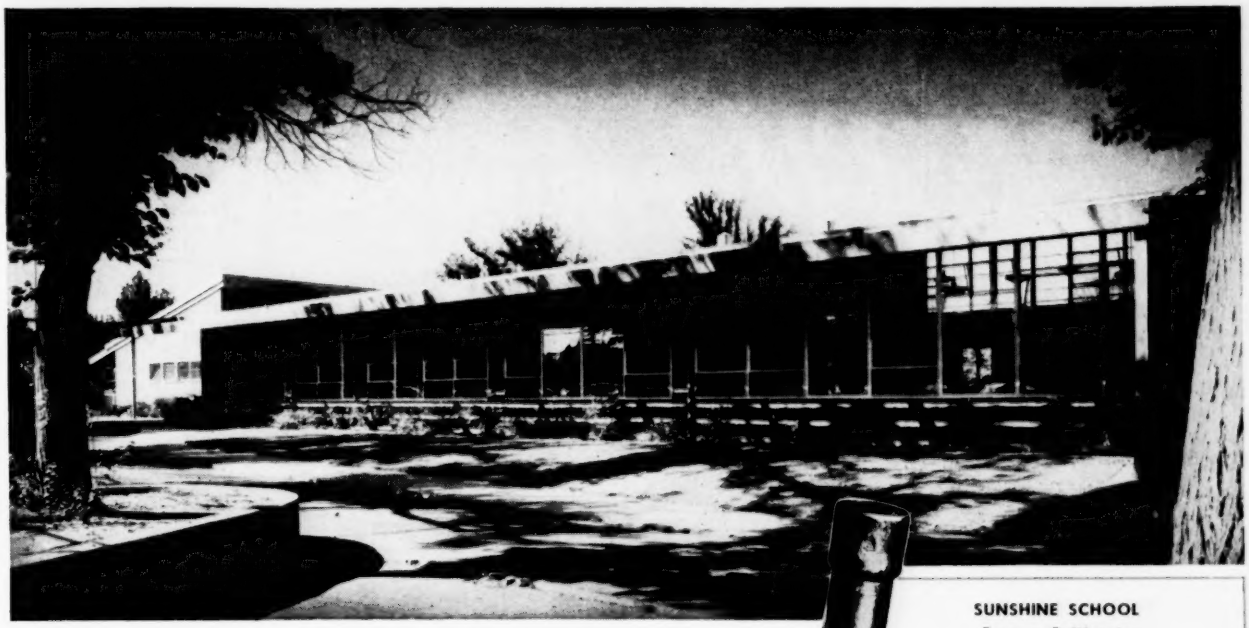
Natural Gas Order No. 2 Terminated. Termination of Natural Gas Limitation Order No. 2, effective March 1, has been announced by the Petroleum Administration for Defense. The order was issued in August, 1951, with the idea of preventing a shortage of natural gas needed for defense production and essential civilian use. The order restricted extension of service to new house-heating customers, and required specific approval by the Petroleum Administration for Defense before beginning service to large-volume industrial users in affected areas.

Order No. 2 was amended in August of 1952 to ease restrictions on deliveries of natural gas for home heating and large-volume use. Special modifications for individual countries have also been granted. At that time, officials of PAD indicated that conditions might improve sufficiently to permit lifting of the order by Spring of 1953.

Refrigeration Components Studied. Studies of standardization possibilities involving hermetic compressors, heat exchangers and accessories are being conducted by subcommittees of the Defense Supply Management Agency Refrigeration and Air Conditioning Industry Advisory Committee. Other industry groups are working on standardization projects in the areas of internal combustion engines, power cranes and shovels, and packaging. The Refrigeration and Air Conditioning IAC, formerly an activity of the Munitions Board, now comes under the Defense Department.

Membership of the heat exchanger subcommittee was awaiting confirmation at press time. The hermetic compressor subcommittee represents a division of responsibilities previously assigned to the compressor committee. The main committee is now concerned primarily with open compressors.

Fuel Study Approved. Continuation until January 31, 1954 of a study of the nation's fuel reserves, as a preliminary to formulating a U. S. fuel policy, has been proposed by the Senate Interior Committee.



SUNSHINE SCHOOL
Fresno, California

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Fresno, California

MECHANICAL CONTRACTORS, STAGE 1
Grenfell & Hunter, Fresno, California

MECHANICAL CONTRACTORS, STAGE 2
Fresno Plumbing & Heating Co., Fresno, California

BYERS WROUGHT IRON PIPE

safeguards welcome warm comfort in radiant heated SUNSHINE SCHOOL

In this prize-winning school (three awards from AASA, one from AIA) every consideration was given to the comfort and convenience of the crippled children it was designed to serve. Extra large door openings, all floors on one level, open-front sinks and work counters and a host of other design solutions reflect the careful planning that went into every detail.

This same care and planning was extended to the heating system. Even, controlled warmth was a "must." The designers answered the need with a radiant heating system. To safeguard the heating system from the health and economic threat of premature failure, Byers Wrought Iron pipe was used for the heating coils.

Protecting radiant heating systems in schools with Byers Wrought Iron pipe is a continuing practice with David H. Horn & M. D. Mortland, architects for famous Sunshine School. Since the introduction of radiant heating, this architect team has employed the system, using Byers Wrought Iron pipe, in fifty schools in the California area.

There are good reasons for this confidence, which is shared by an increasing number of the nation's leading architects. Byers Wrought Iron pipe is readily formed and welded which speeds and simplifies radiant heating installation. It has a high rate of heat emission. It expands and contracts at practically identical rates with concrete. Its mechanical strength withstands damage during installation. And its corrosion resistance has been demonstrated time and time again, over periods of many years.

Our bulletin, BYERS WROUGHT IRON FOR RADIANT HEATING, gives the complete story. Write for your copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N.Y.

Why Genuine Wrought Iron Lasts

This notch-fracture test specimen illustrates the unique fibrous structure of genuine wrought iron—which is responsible for the high corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

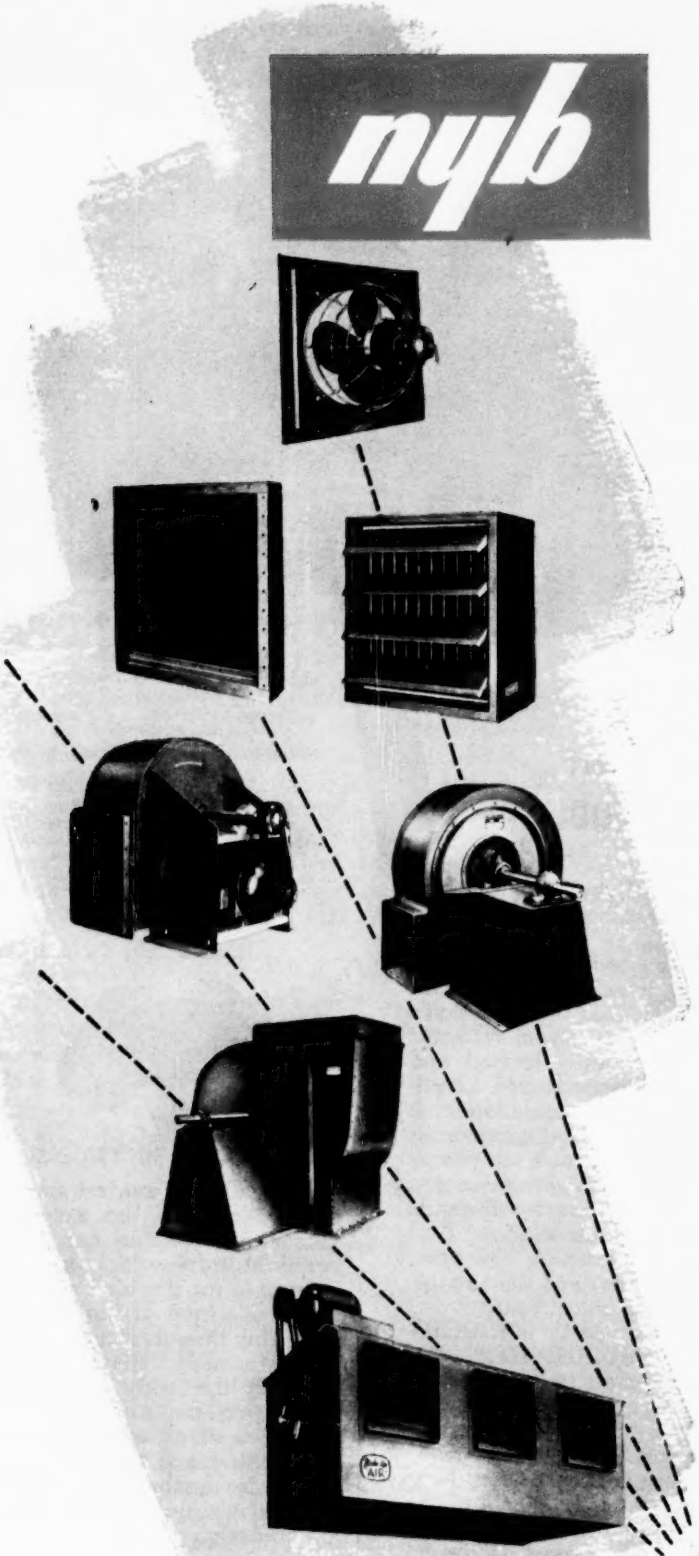
BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS



nyb Announces

TWO NEW BELTED JUNIOR FANS No. 76 and No. 91

QUIET OPERATING
SLOW SPEED WHEEL
ADJUSTABLE AIR DELIVERY

Capacities from 400 to 1400 cfm

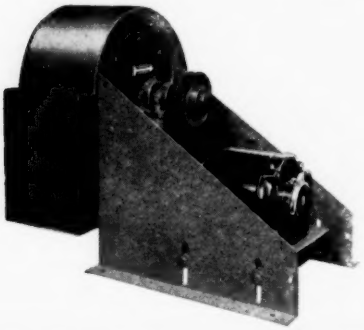
Developed to meet popular demand for a small, adjustable speed V-belt fan, which is quiet in operation and where fan speed can be adjusted in the field.

CAST ALUMINUM SLOW SPEED WHEEL is ideal to meet requirements of small ventilating problems such as exhaust from private offices, washrooms, laboratories, where quiet operation is demanded and precise quantities of air are to be handled. In order to use the Slow Speed wheel for this service, belt driven units are necessary.

V-BELT DRIVES have adjustable motor sheave giving speed adjustments of 30% to 50% depending upon the motor selected.

RUGGED CONSTRUCTION · Realizing that quiet fan operation requires sturdy construction, the same type all-welded steel housing is used as in the larger ***nyb*** ventilating fans.

Write for Bulletin 530



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nyb

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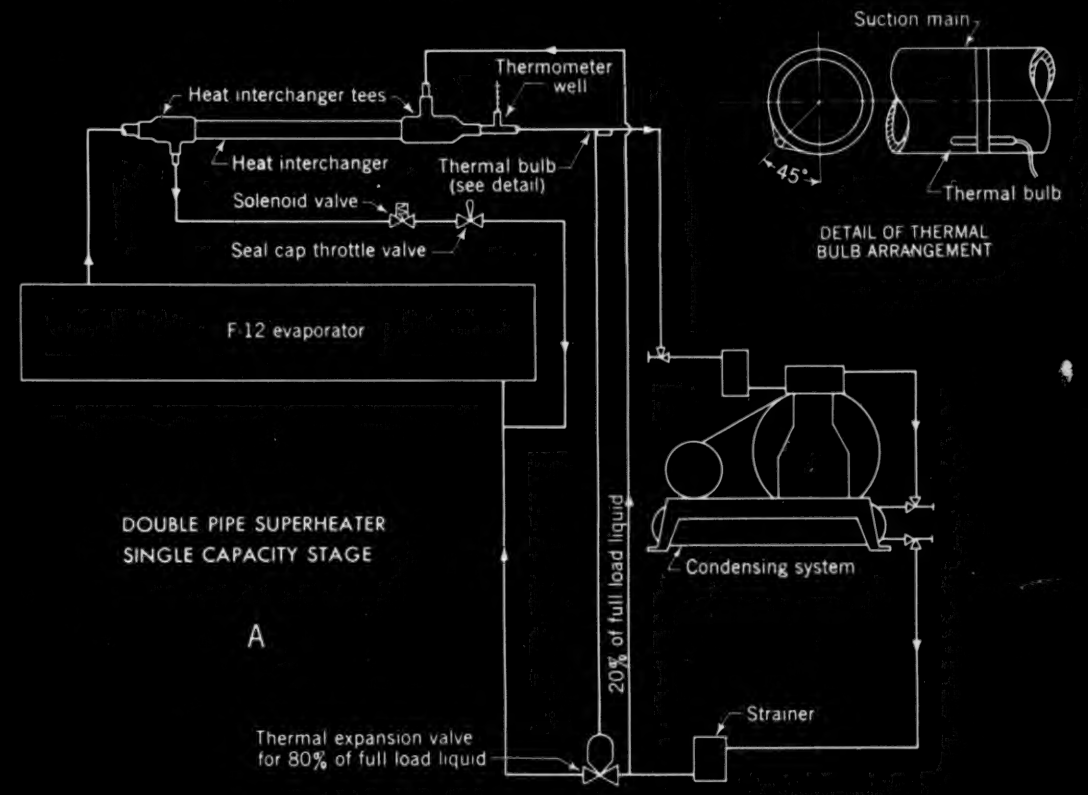
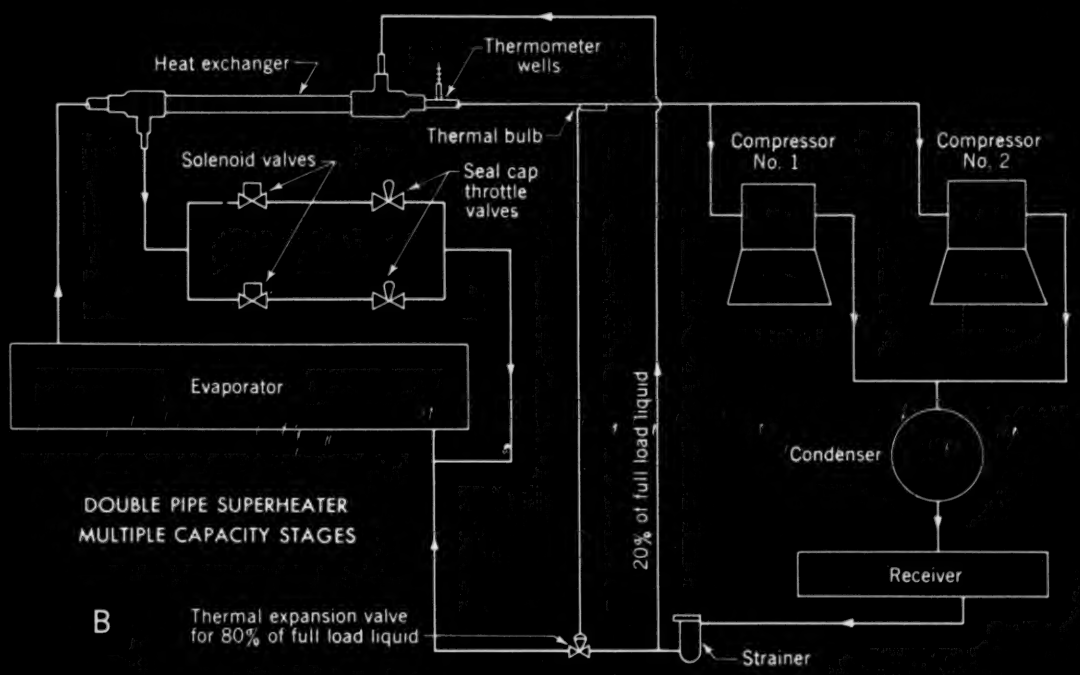
FACTORY, LAPORTE, INDIANA

HEATING AND VENTILATING'S DETAIL SHEET

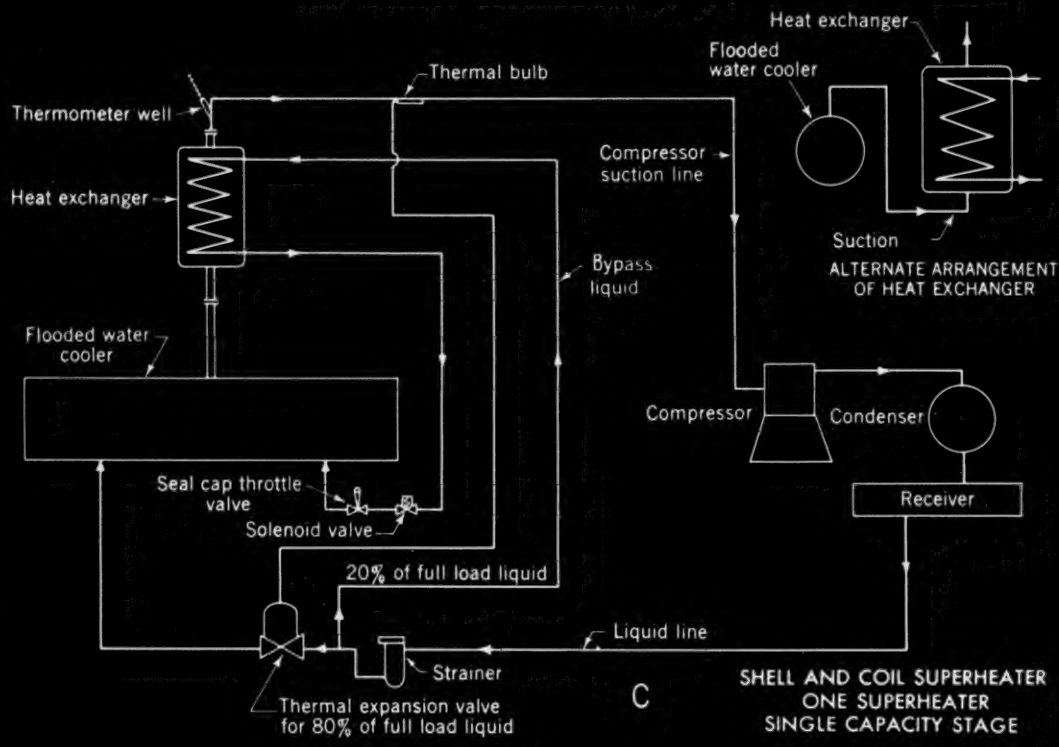
SUCTION GAS SUPERHEATERS IN REFRIGERANT CIRCUIT





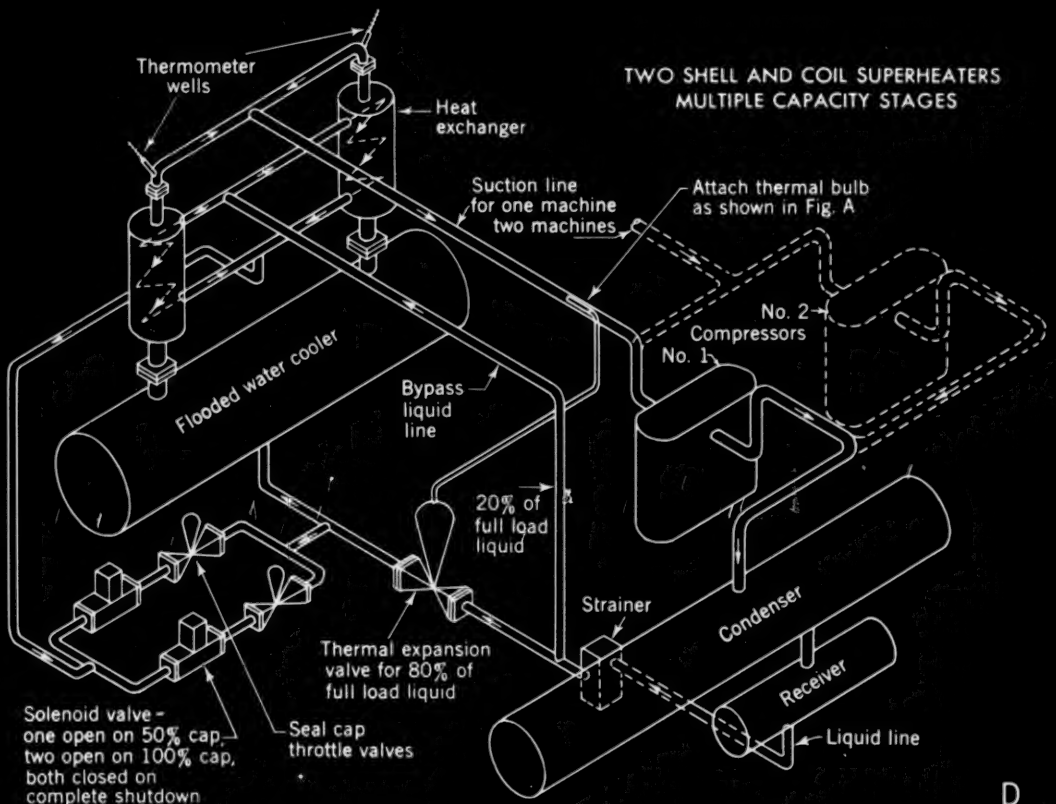
PIPING HOOKUPS THROUGH THE COOPERATION OF YORK CORP., YORK, PA

SUCTION GAS SUPERHEATERS IN REFRIGERANT CIRCUIT



C

SHELL AND COIL SUPERHEATER
ONE SUPERHEATER
SINGLE CAPACITY STAGE


Thermometer wells
Heat exchanger
Suction line for one machine two machines
Attach thermal bulb as shown in Fig. A
No. 2 Compressors
No. 1
Flooded water cooler
Bypass liquid line
20% of full load liquid
Strainer
Condenser
Thermal expansion valve for 80% of full load liquid
Receiver
Solenoid valve – one open on 50% cap, two open on 100% cap, both closed on complete shutdown
Seal cap throttle valves
Liquid line

TWO SHELL AND COIL SUPERHEATERS
MULTIPLE CAPACITY STAGES

D

Tested patterns to meet today's needs . . .

Jenkins cast steel Valves

for dependable economy

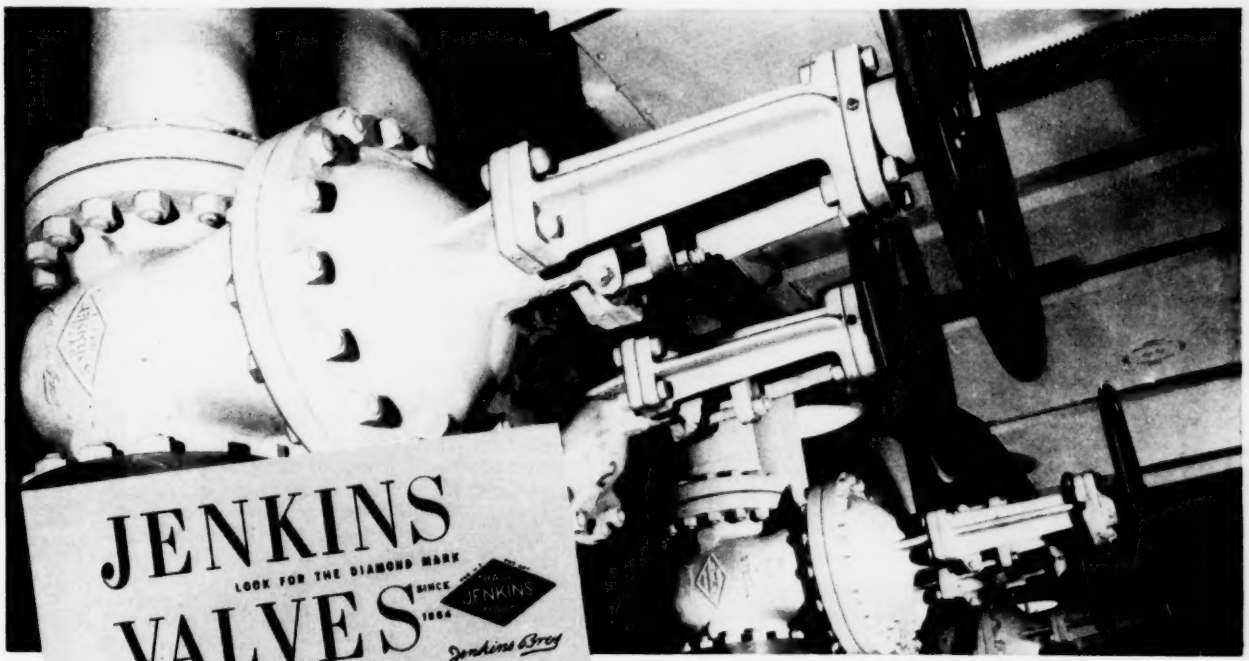
in high pressure

—higher temperature services

Mounting pressures and temperatures in power generation and industrial processing call for Cast Steel Valves. For this increasing need, Jenkins offers a wide selection of patterns that have met the test of the toughest services throughout industry.

In these valves, Jenkins provides a wide margin of strength and safety beyond ratings. Special refinements in design extend their service life, assure long, trouble-free performance. Efficiency and low maintenance records measure up to the high standards established for all valves developed by Jenkins Valve *specialists*.

The new Cast Steel Valve catalog gives complete information. Write for your copy today. Jenkins Bros., 100 Park Ave., New York 17.



Get this NEW Cast Steel Valve Catalog

Describes Globes, Angles, Gates, and Checks with detailed pressure ratings, dimensions, and other technical data covering all patterns of Cast Steel Valves now available from Jenkins. Send the coupon for your copy.

JENKINS BROS., 100 Park Ave., New York 17

Please send catalog of Cast Steel Valves.

Name .....

Company .....

Address .....

.....

Ventilating History was made on the destroyer "Kimberley" in 1917

TYPE M VENTILATOR
At End of Cowl Trunk

When the destroyer "Kimberley" (one of World War I's gallant four-stackers) was built at Boston Navy Yard in 1917, an installation of four Wing-Scruplex Ship Ventilators was made in four of her ventilating cowls.

This marked a milestone in ventilating history, proving the value of propeller fans in marine ventilation, and marking also the use of propeller fans—later known as axial flow fans—by the U. S. Navy.

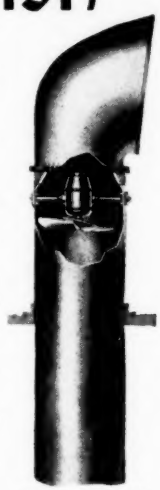
Cowls, dependent upon ship motion or wind velocity to "scoop" air in or lead it out, were of little or no value when a ship was at anchor, or running in a following wind. Powerful Wing (Scruplex) propeller fans, installed directly in the cowl trunks, gave positive ventilation at all times.

The special feature of Wing (Scruplex) propeller fans was their ability to deliver air at high velocities and static pressures.

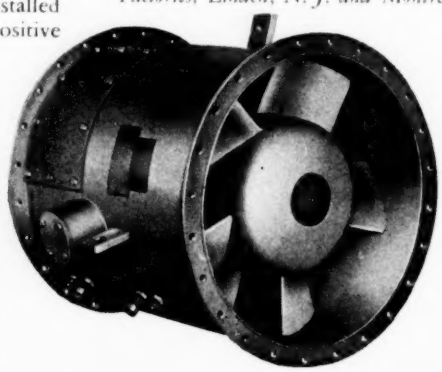
Hundreds of ships, Naval and Commercial, have since been similarly equipped.

Today, with the development of still more powerful propeller fans, as the Wingfoil Axial-Flow Fan, following the same "fan in trunk" idea, the use of extensive air distributing duct systems made it possible to bring positive ventilation to remote parts of the ship.

L. J. Wing Mfg. Co., Linden, N.J.
158 Vreeland Mills Road
Factories; Linden, N. J. and Montreal, Canada

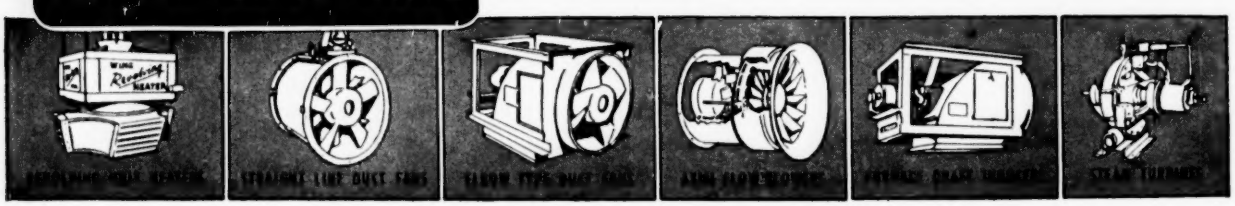


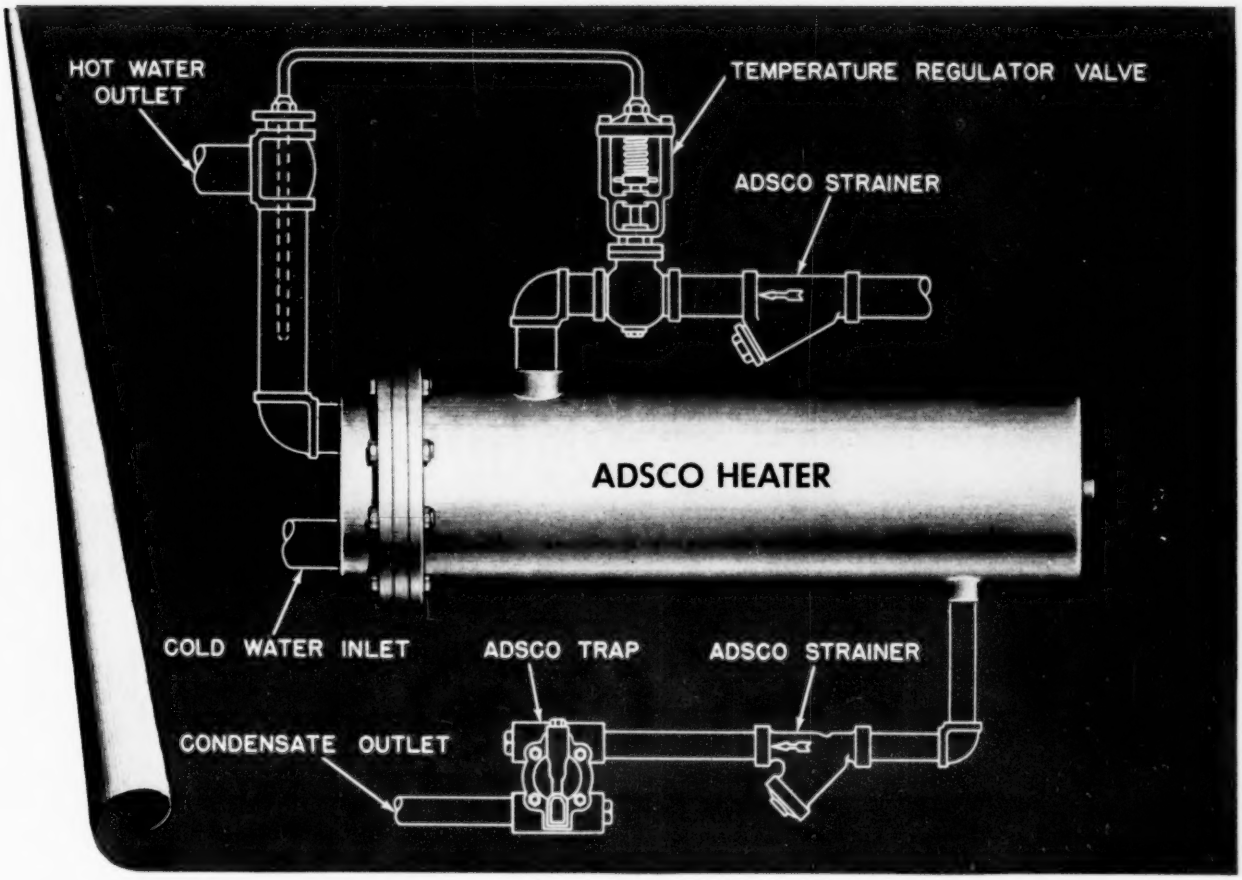
TYPE T VENTILATOR
At Top of Cowl Trunk



Write for detailed information on Wingfoil Axial Flow Fans and Wing-Scruplex Ship Ventilators

Wing
AXIAL FLOW FANS





BLUEPRINT FOR ACTION!

And what action, when you use an ADSCO Water Heater! Hot water . . . when and where you want it . . . and at low cost! ADSCO Instantaneous Heaters furnish industry with general service hot water, boiler feed water, and process water. They supply hotels, apartments, office buildings, dormitories, hospitals, and institutions with hot water for showers, washrooms, dishwashers, laundries, and for general cleaning. ADSCO Convertors, a type of instantaneous heater with a shorter temperature range, furnish *all types* of buildings with hot water for quiet, trouble-free space heating systems.

Yes, you get plenty of action — fast action — out of ADSCO Water Heaters. They operate best when connected according to the typical piping arrangement shown above, with two ADSCO Y-type Strainers to protect valuable equipment and an ADSCO Dual Steam Trap to handle condensate efficiently.

ADSCO Water Heaters have only three parts: shell, tube bundle, and cover. All are made to ADSCO's high standards. Steel shells are seamless steel pipe, carefully cut and welded by skilled workmen. The shell flange is sturdy and accurately machined and all openings are precisely located. The tube bundles are made of pure, deoxidized seamless copper tubes formed into U-bends. By means of electrically and automatically controlled equipment, they are rolled and expanded into carefully drilled tube sheets which have a diamond pitch arrangement for spacing of tubes. The semi-steel covers are high-tensile, fine-grain castings.

For further information, write for Bulletin 35-78 on Instantaneous Heaters or Bulletin 35-77 on Convertors.

ADSCO ENGINEERED PRODUCTS

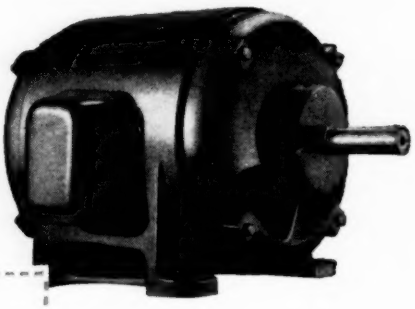
AMERICAN DISTRICT STEAM COMPANY, INC.

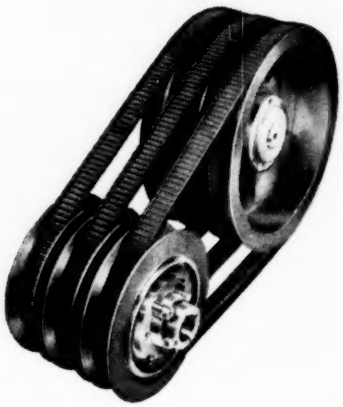
NORTH TONAWANDA, NEW YORK

Since 1877

If Your Problem IS HERE — Between Power

ALLIS-CHALMERS





SEND COUPON

Allis-Chalmers Mfg. Company
Milwaukee 1, Wisconsin

Please send me more information on Allis-Chalmers coordinated equipment.

- ☐ Motors — Bulletin 52B6052
- ☐ Control — Bulletin 14B7132
- ☐ *Texrope* V-belt Drives — Bulletin 20B6051

Name .....

Title .....

Company .....

Address .....

City and State .....

A-3904

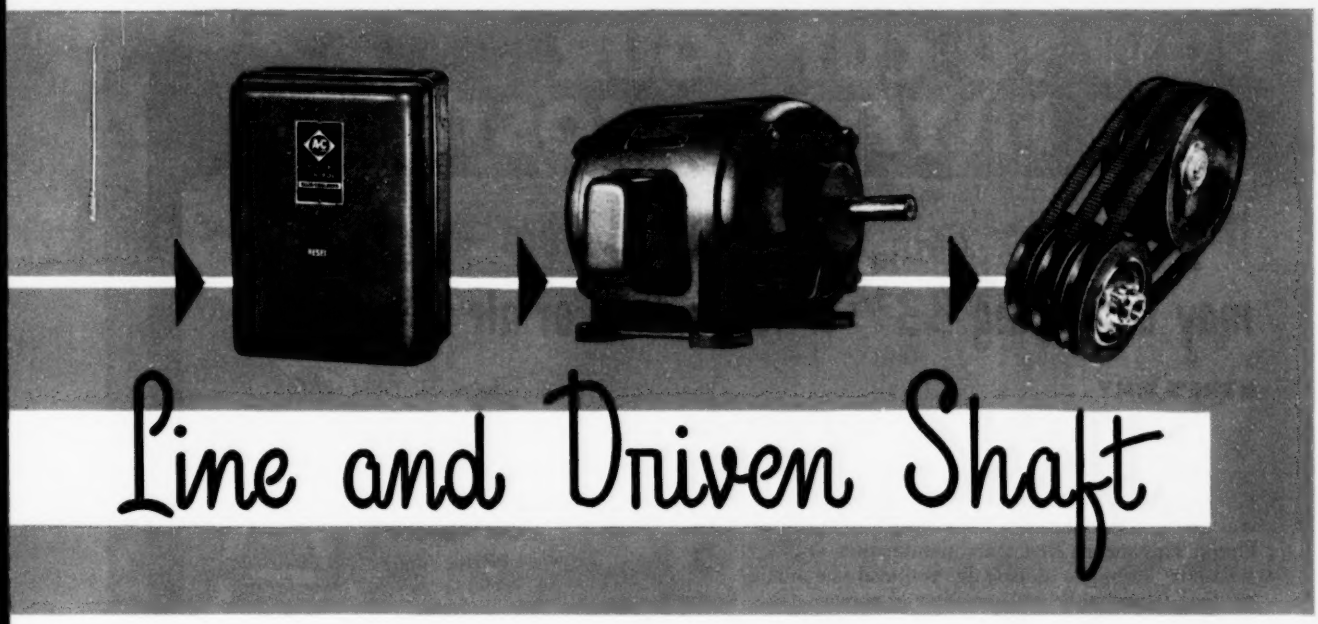
Motors Smooth running and quiet operating. Cast iron frames resist corrosion in humid atmospheres. Double shielded bearings do not ordinarily require lubrication but may be lubricated in service if desired. Sleeve bearing motors available in many sizes if required.

Sizes from ½ hp up. Types include single and multi-speed squirrel-cage, dc, wound-rotor and synchronous. Enclosures include drip-proof, splash-proof, totally-enclosed, non-ventilated, totally-enclosed fan-cooled and explosion-proof. Totally-enclosed and explosion-proof motors built in famous finned design which greatly reduces cleaning problems and costs, or in the tube-cooled design which gives the same maintenance savings in the larger sizes.

TEXROPE Drives — The original multiple V-belt drive and the most complete line of V-belt drive products in the industry. *Super-7* V-belts feature grommet construction in all but the smallest sizes. Also available in high-capacity, oil-resisting, static-conducting type.

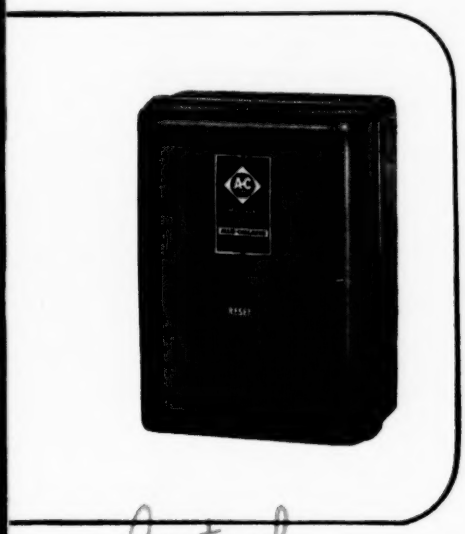
Variable speed sheaves for fans and pumps provide a simple, inexpensive method of controlling output. Saves time in balancing systems, simplifies seasonal adjustments. Allis-Chalmers variable speed sheaves include *Vari-Pitch* sheaves for stationary or motion control with both standard and wide range adjustments.

Constant speed sheaves include *Texsteel* sheaves and *Magic-Grip* easy mounting sheaves in a complete range of sizes.



Line and Driven Shaft

CAN HELP YOU



Control — There is an Allis-Chalmers control to meet every requirement of motor operation through the complete range of motor sizes. Manual and magnetic, reversing and non-reversing, across-the-line and reduced voltage starters are included. Push button and pilot devices are available in any number of positions and in all combinations. Accessory Allis-Chalmers control equipment includes dc contactors, timing relays, contactors for heavy duty starting and rotary control switches.

YOU CAN SAVE TIME, SAVE WORK, SAVE MONEY and be sure of your fan, pump and compressor drives when you use coordinated components from Allis-Chalmers. For Allis-Chalmers can supply you with control, motor and *Texrope* V-belt drive for your machine . . . all of integrated design and manufacture.

Unit Responsibility

By using Allis-Chalmers coordinated drive components, you save paperwork and the time and cost of matching parts from different sources. More important, you know the components will fit together properly . . . that assembly will be completed quickly and easily.

And you don't have to worry about passing the buck on service. Allis-Chalmers stands behind the complete drive and takes responsibility for the proper functioning of every part.

Delivery from Stock

Immediate delivery from stock can be had on nearly all standard items from warehouses and distributor stocks located all over the country.

Allis-Chalmers representatives are experienced in air conditioning problems and can give you the kind of help you need in selecting the best drive for your machine. And this team of field experts is backed up by a large factory engineering staff.

Certified Service

Allis-Chalmers continues to serve you after the sale with nearly a hundred Certified Service Shops located in every industrial area in the country. Allis-Chalmers Certified Service Shops are carefully selected independent service shops that use only factory-approved parts and methods in complete servicing of Allis-Chalmers equipment.

Texrope, Texsteel, Magic-Grip, Vari-Pitch, and Super-7 are Allis-Chalmers trademarks.

ALLIS-CHALMERS

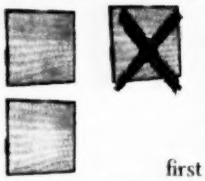
HOW TO CUT YOUR AIR FILTERING COSTS 1/3!

If you are not using FAR-AIR* filters – you may be paying 33⅓% too much for air filtration!

HERE'S WHY...

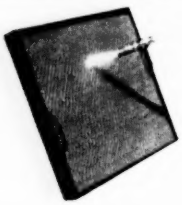
FAR-AIR filters with their many exclusive design features are the first and original high velocity air filters. Each unit is engineered to hold *more* dirt, handle *more* air with *less* pressure loss and give *greater* efficiency than other impingement filters. This means that your maintenance and installation costs are drastically reduced—so much so, that it probably will pay you to replace your present filters with FAR-AIR.

1/3 SPACE SAVING



Because these filters handle 50% more air per unit with less pressure loss, two FAR-AIR filters will do the work of three ordinary types. You make substantial savings in first cost through smaller plenum chambers and fewer filters and holding frames.

CUT MAINTENANCE UP TO 60%



FAR-AIR filters hold more dirt per unit without decreased efficiency, so maintenance is cut approximately ½. Also, due to the media design, they can be cleaned by simply flushing with a hose.

These filters can even be cleaned and reoiled without removing them from the filter bank! All these points add up to less maintenance time and cost than you would believe possible.

"LIFETIME ENGINEERING" SAVES YOU MONEY

Extra quality in construction allows these filters to far outlast ordinary types. Sixteen gage steel filter and holding frames assure well-aligned, rigid filter banks. Reinforcing rods drilled through the media make distortion virtually impossible. Felt linings prevent air bypass. Firmly packed media provides even density and assures uniform high efficiency over the entire filter area.

EXCLUSIVE PROGRESSIVE LOADING FEATURE GIVES YOU MORE EFFICIENT FILTERING

The famous herringbone-crimp design of the media allows the filter to load with dirt progressively through the entire filter, not just on the face. There is exceptionally low pressure loss even on a fully loaded filter because channels in the media allow passage of air. You get more efficient filtering over a longer period of time as a result.

OTHER FAR-AIR PRODUCTS INCLUDE:

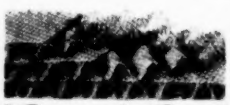
SELF-WASHING FILTERS
KITCHEN GREASE ELIMINATORS
ENGINE AND COMPRESSOR FILTERS
ROTARY (EVAPORATIVE) COOLERS
AIR BAFFLE EQUIPMENT
FILTER SERVICING EQUIPMENT

Check the many money-saving features of FAR-AIR filters...

Mail the coupon, today!

*Trade Mark

FAR-AIR FILTERS



"Better by Farr"

FARR COMPANY

Manufacturing Engineers

Los Angeles • Chicago • New York

M'f'd under license by Control Equipment Co. Ltd., Montreal

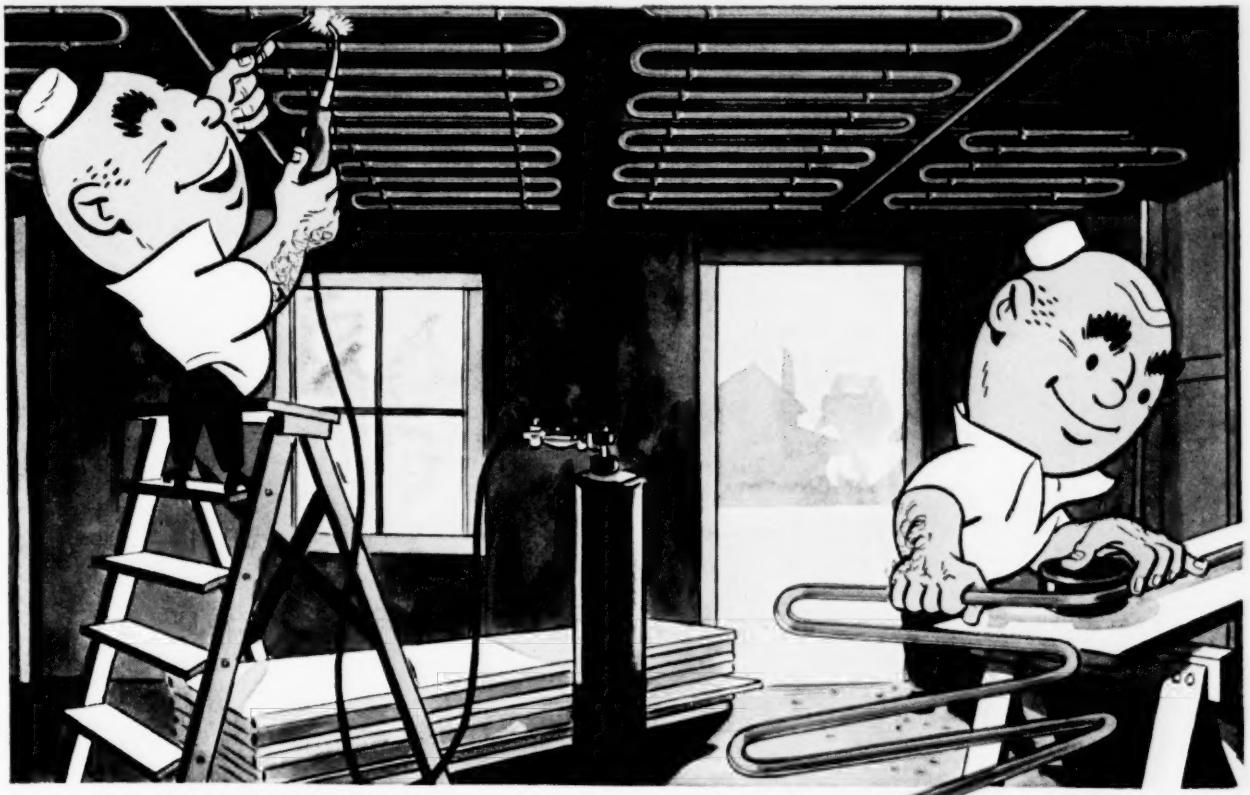
FARR COMPANY, P. O. Box 10187 Airport Station
Los Angeles 45, Calif.

Gentlemen: Please send me complete information on FAR-AIR filters. I ☐ would ☐ would not like a Farr Field Engineer to assist me with my filter problems.

NAME _____ TITLE _____

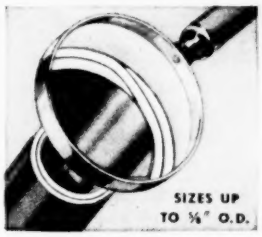
COMPANY _____

ADDRESS _____



Rugged, lightweight Bundyweld Tubing can be formed by one man, mounted by two. Joining is swift and sure. Coils lie flat and straight, are plastered over quickly. Tough steel resists accidental damage.

Show your heels to competition . . . with Bundyweld Ceiling Radiant Heating



Key to Low Cost

Bundyweld is the only tubing double-walled from a single strip, copper-brazed through 360° of wall contact. It's leakproof, thinner walled, yet stronger. It transmits heat quickly, has high bursting strength. It saves on material costs and installation time.

Standard 20′ lengths of Bundyweld are easily formed into coils in shop or on job site. Expanded ends (furnished when specified) are quickly soldered into leakproof union. Joined, lightweight coils are easily mounted onto ceiling, quickly plastered over.

Here's your chance to grab the lead, leave competition 'way behind for years to come.

Take on Bundyweld Ceiling Radiant Heating, the *new* system with all these sales points: Heat is even, for comfort *anywhere;* it's amazingly clean, trouble-free; yet it actually costs *less* to run. Day by day it's making other heating methods more obsolete.

And buyers are learning about it, too. People by the millions are reading Bundy ads in *Better Homes and Gardens, American Home,* and *House Beautiful.* They're swamping Bundy with requests for literature. And from every part of the country, people are writing for the names of plumbing and heating contractors who handle Bundyweld Ceiling Radiant Heating *in their localities.*

The bandwagon is coming, but you can be 'way out in front of it. Send for your free literature now.

Radiant Heating Division
BUNDY TUBING COMPANY
Detroit 14, Michigan

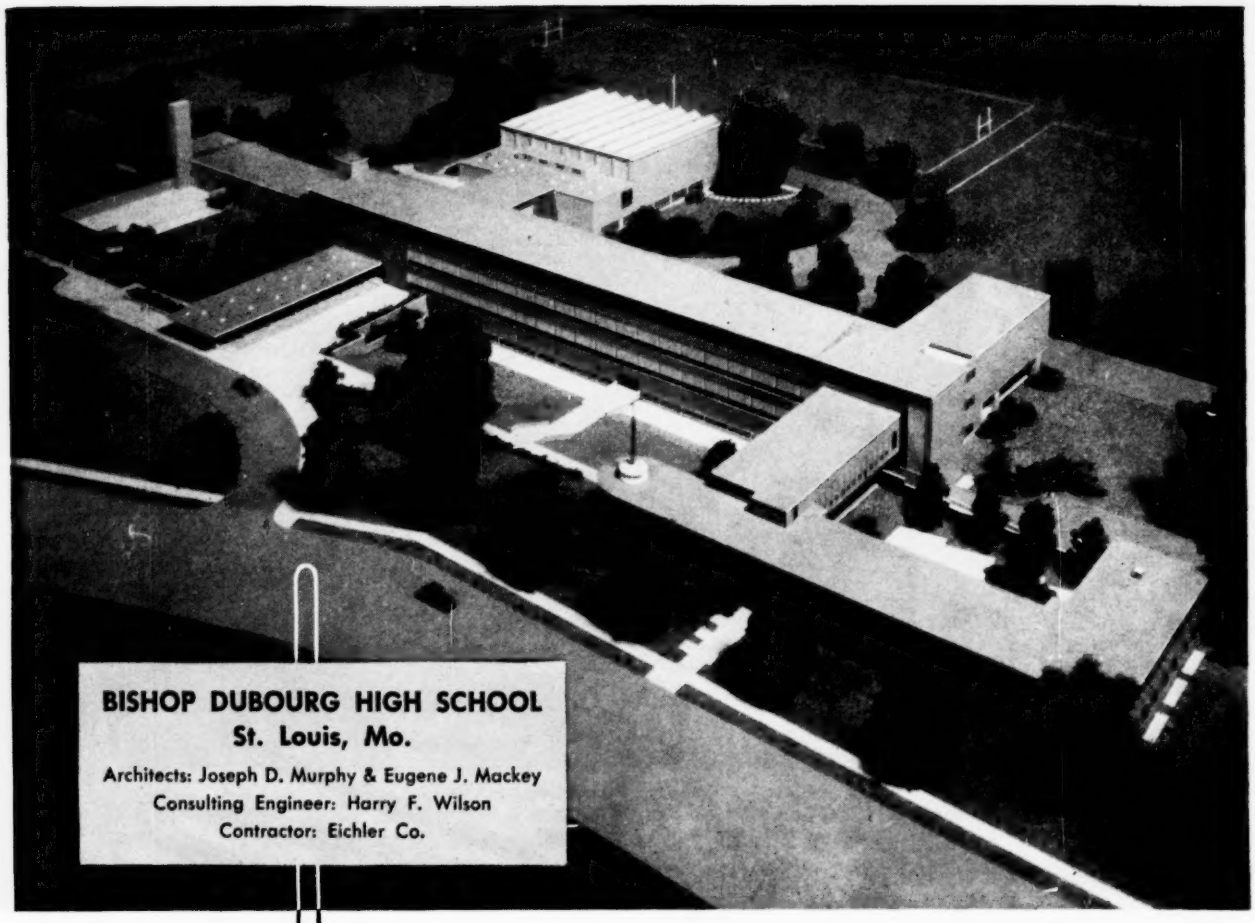
SEND FOR FREE LITERATURE!

Bundyweld
Ceiling Radiant Heating

Radiant Heating Division, Dept. HV353
Bundy Tubing Company, Detroit 14, Mich.

☐ Send free 20-page nontechnical brochure explaining Bundyweld Ceiling Radiant Heating.
☐ Send Bundy technical radiant heating pamphlet.

Name _____ Title _____
Company _____
Address _____
City _____ Zone ____ State _____



BISHOP DUBOURG HIGH SCHOOL
St. Louis, Mo.

Architects: Joseph D. Murphy & Eugene J. Mackey
Consulting Engineer: Harry F. Wilson
Contractor: Eichler Co.

173 POWERS Day-Night Thermostats control 226 valves on Convectors and 69 Unit Ventilators.

Another Outstanding Modern High School

POWERS *Controlled*

Among the many economical features included in the unique four story $3,000,000 Bishop DuBourg High School is a Powers pneumatic system of temperature control.

Superiority of Powers Unit Ventilator Control here will not only provide greater comfort but will hold down operating costs. Its continuous dependable operation is due to the basic simplicity of Powers Low-Limit Airstream Thermostats. They need no auxiliary devices to supplement their accurate control of Unit Ventilator discharge temperatures. Their adjustable sensitivity gives precise control.

Powers control of unit ventilators and convectors results in greater comfort and fuel economy. With today's high fuel cost Powers temperature control is a more profitable investment than ever before. When problems of temperature control arise contact Powers nearest office. Our more than 60 years of experience may be helpful to you.

(b7)

Established in 1891 • **THE POWERS REGULATOR COMPANY** • SKOKIE, ILL. • Offices in Over 50 Cities

New!

*Look what Powers has done to **Modernize** Control Valves*

Powers NO-PAK Valves Banish Packing Maintenance
Prevent leakage of water or steam or loss of vacuum

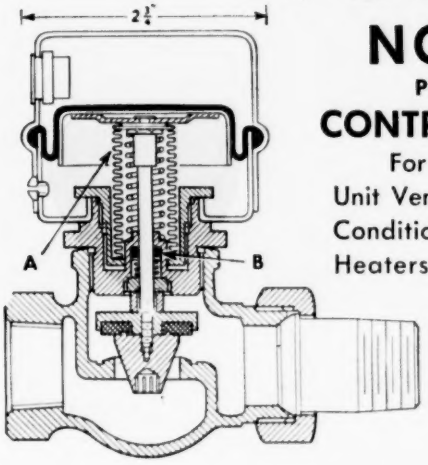
POWERS

NO-PAK

Pneumatic

CONTROL VALVES

For Convectors, Unit Ventilators, Unit Air Conditioners, Baseboard Heaters, Radiators, etc.



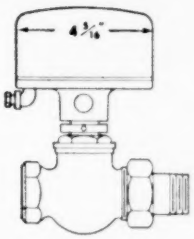
Various Types and Sizes for all requirements

Another POWERS Contribution to Better Heating and Air Conditioning Control

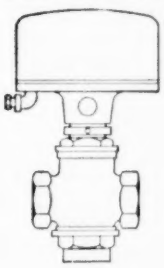
NO-PAK valves with their many advantages are now standard with Powers temperature control systems. Their superior performance is due to Duo-Seal construction.

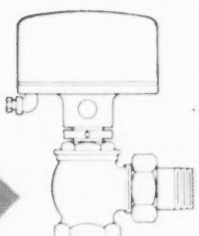
Bronze Packless Bellows (A) in sectional view above, is the primary seal which eliminates packing maintenance — packing friction — steam and water leakage or loss of vacuum. It is designed to withstand pressure up to 150 psi. Maximum valve stroke is only two-thirds of the normal bellows stroke. A spring loaded secondary seal (B) permits servicing of valve top without draining the water system or shutting down the steam heating system. Seal is made of highly elastic neoprene and is ready to act at any time. Small contact between seal and the highly polished stainless steel stem makes friction a negligible factor.

For utmost dependability and lowest cost maintenance specify control by Powers NO-PAK Valves.

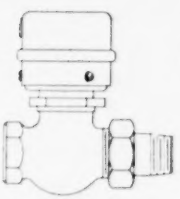


Straightway Union
3-Way Screwed Ends

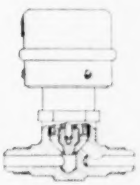




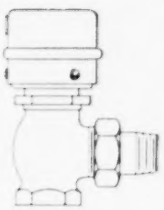
Angle Union



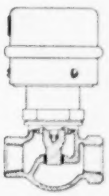
Straightway Union



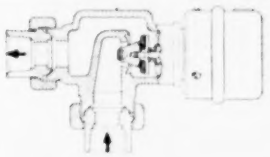
Flared Ends



Angle Union
Screwed Ends

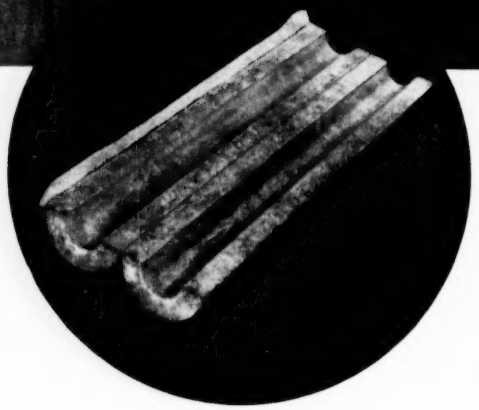


Below: Reverse Flow Double Union



(62)

take a long look at the insulation you never have to look after.... Amocel



That's right! Unarco Amocel is as maintenance-free as an insulation can be—light, strong, durable ,efficient. It's unharmed by moisture, steam, fumes; withstands impact and vibration; may be removed and reused repeatedly without damage or efficiency-loss.

Amocel, a Unarco exclusive, brings to commercial insulation applications many of the excellent features already made famous by Unarco Unibestos—the higher-temperature stand-out. You'll like its easy installation, its clean appearance, its year-after-year effectiveness.

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ature Regulator

Citizens General Hospital, New Kensington, Pa.

Sarco is taking a prominent part in the present active hospital construction and expansion program. Orders coming from every section of the country show that Sarco specialties enjoy national acceptance by hospital architects, engineers and contractors for heating, kitchen and hospital equipment, and temperature control for water heaters. Ask for catalog 200-3.

A few of the Hospitals for which Sarco specialties have been ordered during the last year.

State	*City*	*Hospital*
Ariz.	Phoenix	St. Joseph's Hospital
Colo.	Denver	Veterans Administration Hospital
Conn.	Derby	Griffin Hospital
Conn.	Norwich	Norwich State Hospital
Conn.	Willimantic	Windham Community Memor.
Fla.	Tampa	S. W. Fla. T.B. Sanatorium
Ga.	Monticello	Jasper County Hospital
Idaho	Boise	St. Adolphus Hospital
Ill.	Chicago	Michael Reese Hospital
Ill.	Evanston	Evanston Hosp.–Bldgs. A, B & C
Iowa	Audubon	Audubon County Hospital
Iowa	Cedar Rapids	St. Lukes Hospital
Ky.	Louisville	Veterans Administration Hospital
Mich.	Detroit	Receiving Hospital
Minn.	Fort Snelling	Veterans Administration Hospital
Minn.	Redwood Falls	New Hospital
Md.	Cheverly	Prince Georges County Hospital
Miss.	Hazelhurst	Copiah County Hospital
N. J.	Newton	Newton Memorial Hospital
N. J.	Secaucus	Hudson County Hospital
N. Y.	New York City	Beth El Hospital
N. Y.	New York City	E. Bronx T. B. Hospital
N. Y.	Beacon	Matteawan State Hospital
N. Y.	Buffalo	Roswell Park State Hospital
N. Y.	Ithaca	Herman M. Biggs Memorial
N. Y.	Utica	Utica State Hospital
N. Y.	Walton	Delaware Valley Hospital
Ohio	Ashtabula	Ashtabula General Hospital
Ohio	Dayton	St. Elizabeth's Hospital
Pa.	Danville	Danville State Hospital
Pa.	Embreeville	Embreeville State Hospital
Pa.	New Kensington	Citizens General Hospital
Tex.	Corpus Christi	Corpus Christi Memorial Hospital
Tex.	Denton	Flow Memorial Hospital
Va.	Suffolk	Louis Obici Memorial Hospital
Wash.	Seattle	Veterans Administration Hospital
Wis.	Madison	Madison General Hospital
Wyo.	Buffalo	Buffalo Hospital

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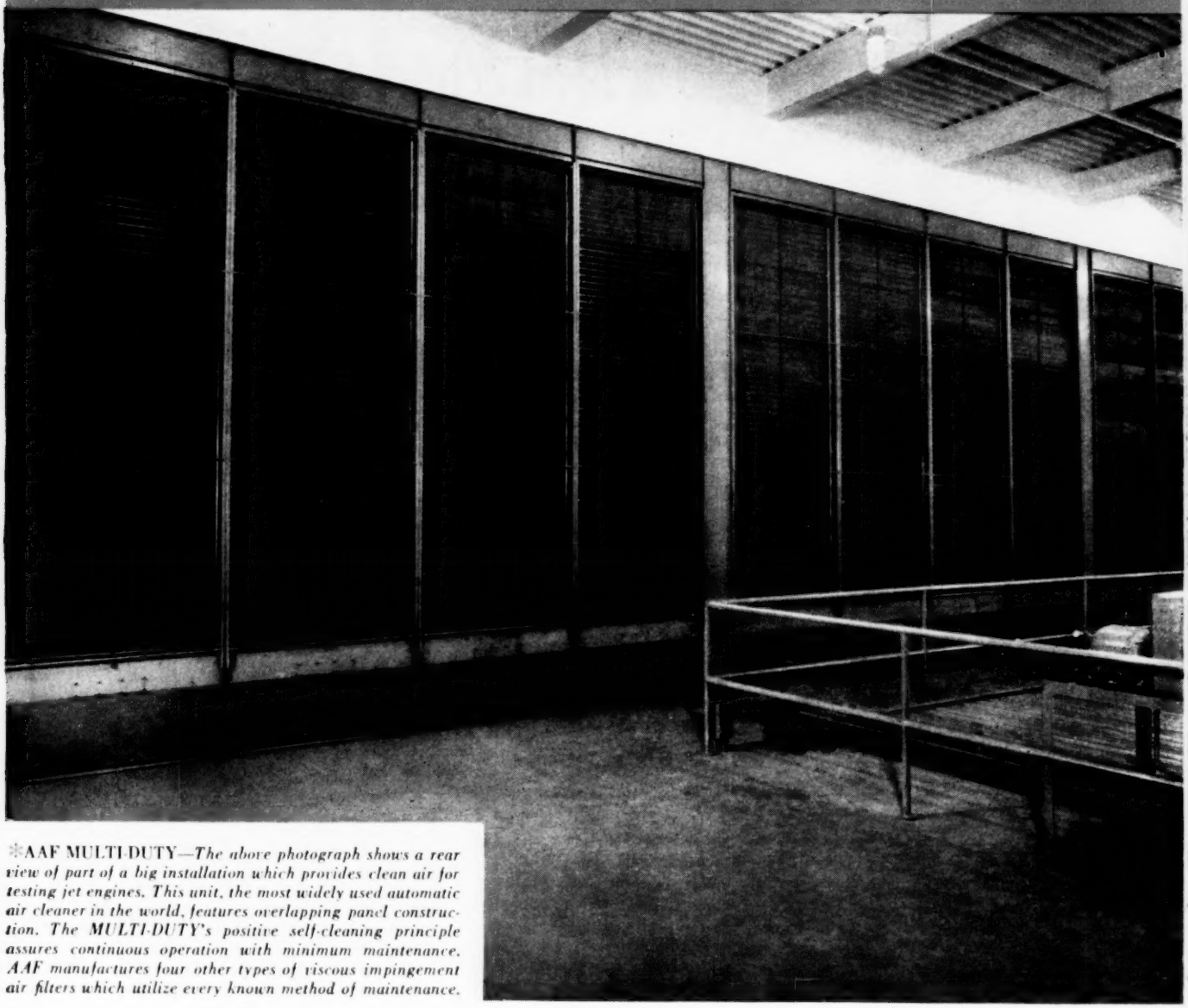
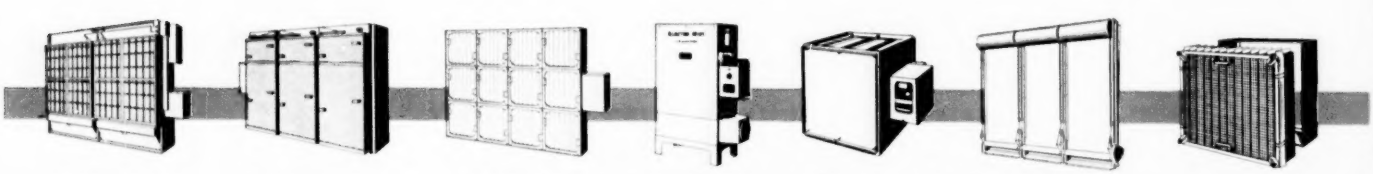
Why are 5 types* of



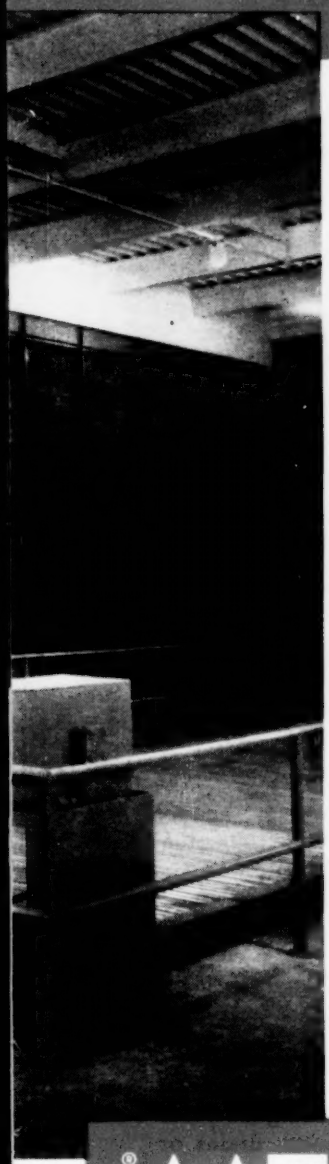
*AAF MULTI-DUTY—*The above photograph shows a rear view of part of a big installation which provides clean air for testing jet engines. This unit, the most widely used automatic air cleaner in the world, features overlapping panel construction. The MULTI-DUTY's positive self-cleaning principle assures continuous operation with minimum maintenance. AAF manufactures four other types of viscous impingement air filters which utilize every known method of maintenance.*

a single source for all air cleaning equipment . . .



ELECTRO-MATIC | ELECTRO-CELL | ELECTRO-PL | ELECTRO-MIST | ELECTRO-KLEAN | AUTO-AIRMAT | AIRMAT PL-24

viscous air filters needed?



IT'S A GOOD QUESTION since other companies only make *one* or *two* types! However, the answer makes sense to engineers! AAF's five distinct types of vicous impingement filters offer the needed latitude in specifying the right filter for a particular job. The engineer working with AAF equipment is able to easily pin-point an efficient solution to his problem with greatest economy to the user.

Each type has individual characteristics affording unequalled flexibility in combining the following factors • Cleaning Efficiency • Maintenance Methods • Space Requirements • Sizes and Air Volumes • Practical and Realistic Range of Costs.

Following are the five types of AAF viscous impingement filters:

- ✻MULTI-DUTY—Permanent self-cleaning and fully automatic filter with exclusive overlapping panel construction.
- ✻M/W Unit—Washable filter for heavy duty industrial service.
- ✻HV Unit—High velocity washable filter with exclusive media design for commercial and industrial applications.
- ✻RENU-*glas*—Low cost filter with replaceable glass filament pads in permanent metal frame.
- ✻AMER-*glas*—Throw-away filter with fine glass filament media.

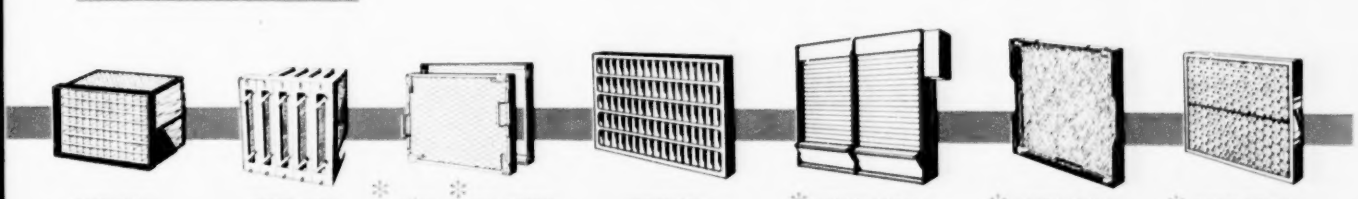
In addition to a complete line of air cleaning equipment AAF also offers the services of a nationwide engineering staff, which is recognized as the leading authority in this field. The specialized knowledge of these experts can save you time, effort and expense and is at your disposal.

American Air Filter
COMPANY, INC.

294 Central Avenue, Louisville 8, Ky.

AMERICAN AIR FILTER OF CANADA, LTD., MONTREAL, P. Q.
PACIFIC DIVISION OFFICE, SAN FRANCISCO, CALIFORNIA

®AAF

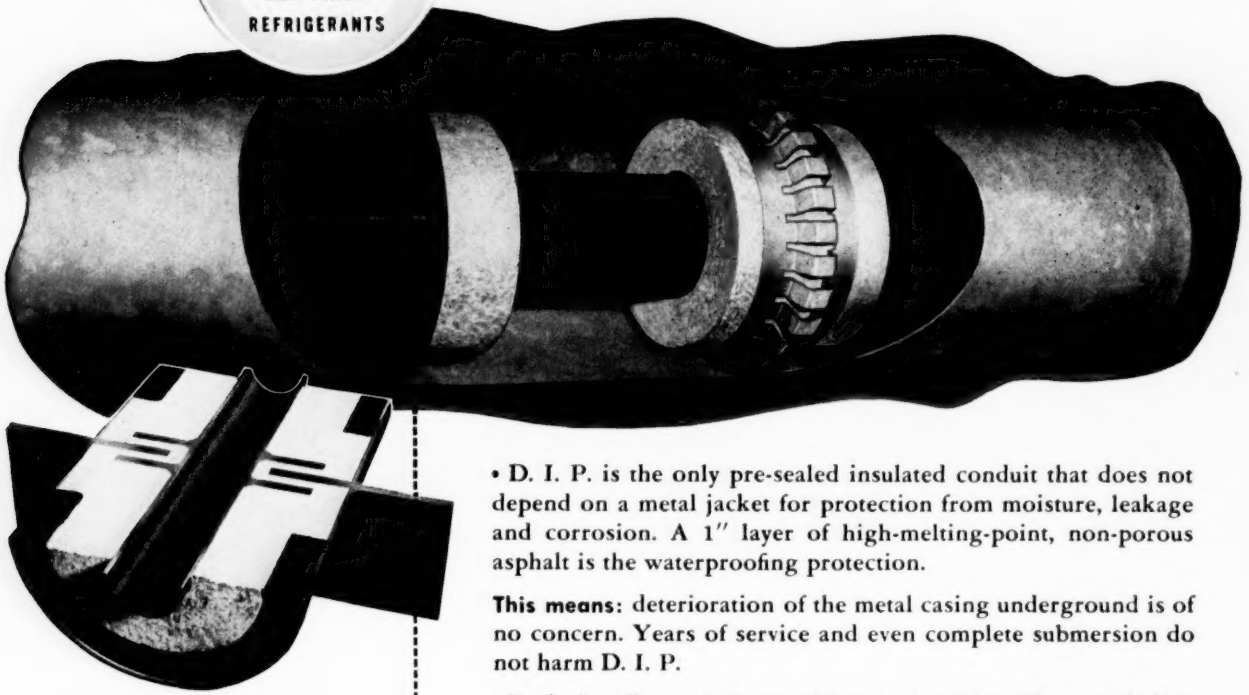


DEEP-PAK | DEEP BED | ✻ M/W & ✻ HV UNITS | DRIFILTER | ✻ MULTI-DUTY | ✻ RENU-GLAS | ✻ AMER-GLAS

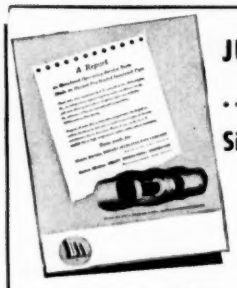
D.I.P.®

FIRST IN THE FIELD OF PRE-SEALED INSULATED PIPING FOR STEAM HOT WATER REFRIGERANTS

Only DURANT Pre-sealed Insulated Pipe gives you these features:



Durant Patented Insulated Anchor



JUST OFF PRESS ... A Report on Simulated Operating Service Tests Made on D.I.P.

This 6 page bulletin contains a detailed report on methods, temperature recordings and results of recent tests made by an independent engineering firm to determine (1) temperatures developed in and near D.I.P. conduit buried 48" underground, and (2) effects, if any, on D.I.P. due to high temperature and water-soaked insulation.

May we have your address so we can mail you a copy ?

• D. I. P. is the only pre-sealed insulated conduit that does not depend on a metal jacket for protection from moisture, leakage and corrosion. A 1" layer of high-melting-point, non-porous asphalt is the waterproofing protection.

This means: deterioration of the metal casing underground is of no concern. Years of service and even complete submersion do not harm D. I. P.

• By design, Durant's Patented Supporting Ring allows asphalt to flow through openings during fabrication to *encase* the ring.

This means: water or moisture cannot pass through support points to the insulation or pipe. It means efficient insulating properties and extreme durability.

• Durant's Patented Insulated Anchor eliminates contact between anchor plate and pipe.

This means: reduced heat loss and elimination of corrosive electrolytic action at anchor points.

Many other advantages come with D. I. P.—such as low cost installation, for the Durant field joint can be made swiftly and easily. D. I. P. does not require external casing-welding: nor does it require concrete tunnels, slabs, rollers, supports, drains or additional protection for superimposed loads—such as under roadways or railroad tracks. Steam pressures to 1000 psi.

Durant's engineering staff and representatives are at your service. Write us today for Catalog 3-G.

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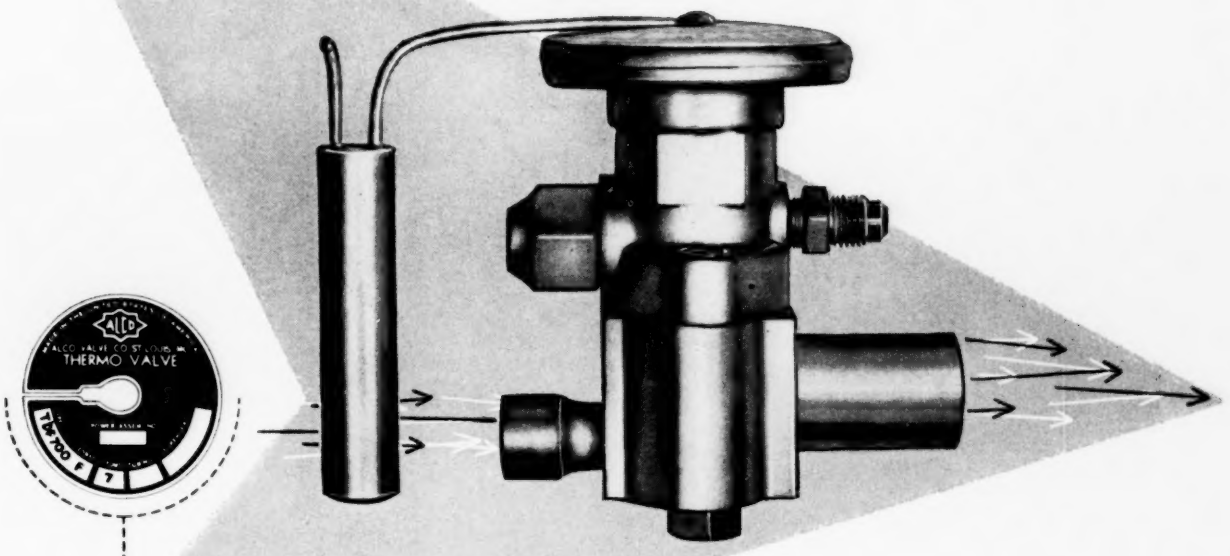
NEW! for tight spots



ALCO "T" SERIES THERMO VALVES with "STRAIGHT-THROUGH" CONNECTIONS

New description code for all ALCO VALVES: The type number expresses the capacity:

EXAMPLES:
TCL 200 = 2 tons
THL 5000 = 50 tons

This makes it easier for you to select the right valve, to keep stock and to avoid errors.

Easy to install in tight spots. You work from *above* . . . no twisting and turning. "Straight-through" connections fit over any type of distributor. They give you the same easy, on-the-line servicing features as Alco "T" Valve with angle-type connections.

When ordering, please specify whether "angle-type" or "straight-through" connections are desired. For "Freon-12", "Freon-22", Methyl Chloride. Write for further information.

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ALCO VALVE CO.

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Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

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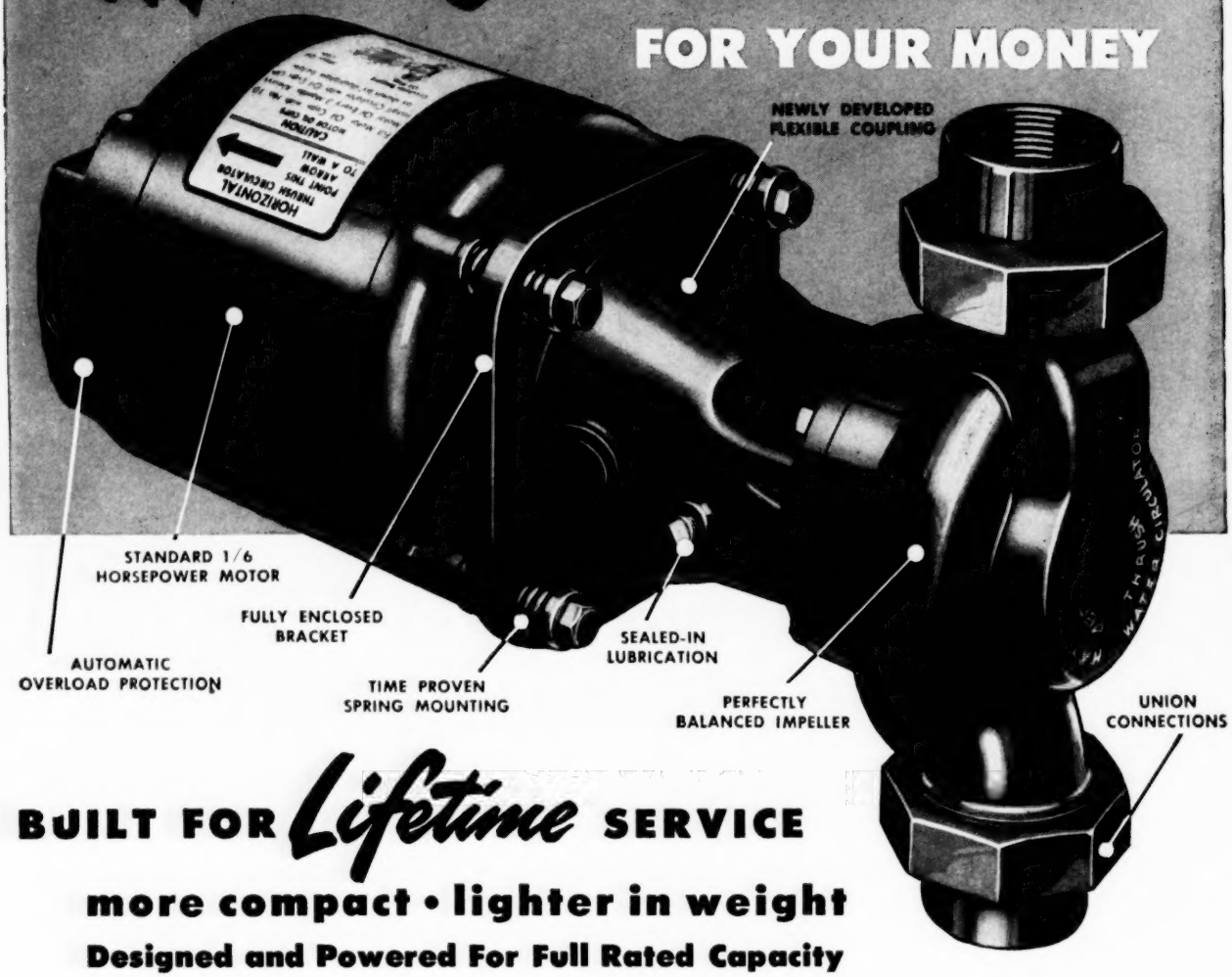
Thrush advanced engineering means

More Circulator FOR YOUR MONEY



BUILT FOR *Lifetime* SERVICE

more compact • lighter in weight

Designed and Powered For Full Rated Capacity

HERE ARE Circulators of improved design to meet today's hot water heating needs. They will fit more places, give better service and help you get more jobs. Here's why —

- *Rugged.* Powerful motors with overload protection. No sacrifice in horsepower.
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- *Sealed-in lubrication.* Perfectly balanced impeller. Fully enclosed bracket.
- *Ideal for zoning.* Sizes to fit every heating requirement. Easier to install.

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HORIZONTAL WATER CIRCULATORS

For more facts about Thrush job-rated Circulators, see your wholesaler or write Dept. D-3.

H. A. THRUSH & COMPANY

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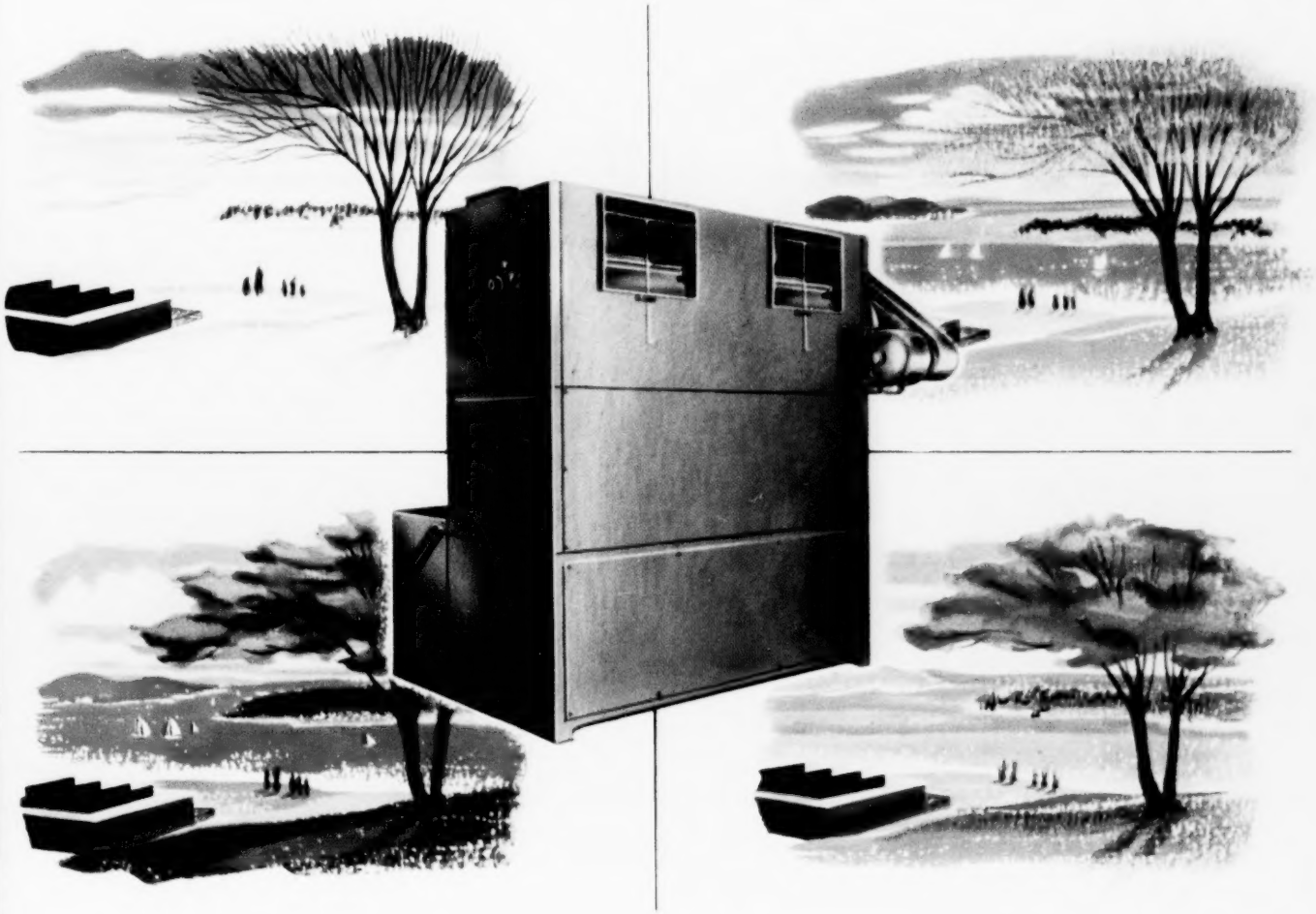
American Blower – a time-honored name in air handling



American Blower Air Conditioning units are designed for summer cooling and dehumidifying and winter heating and humidifying.

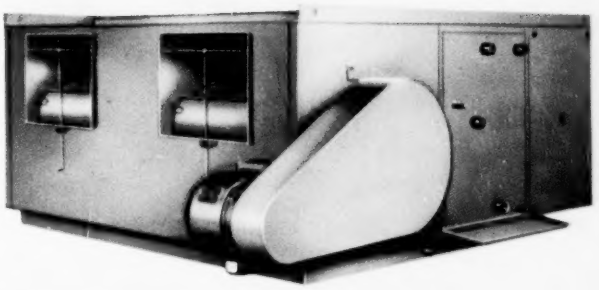
This dual function by the same piece of equipment results in substantial savings in cost and offers much in comfort.

Three types are available: the Type A Conditioner for normal unitary type applications, the Type S Conditioner for unitary type application where washed air or high relative humidities are required, the Type M Conditioner for central system installation.

For data, consult the nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation



American Blower Type A Conditioner. Capacities from 1000 to 13,606 cfm. Either direct expanded refrigerants, chilled water, well water or brine can be used for cooling and steam or hot water for heating.

AMERICAN BLOWER

YOUR BEST BUY IN AIR HANDLING EQUIPMENT

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS & WALL TILE · DETROIT CONTROLS · KEWANEE BOILERS · ROSS HEATER

The New Louisiana Purchase

EVERY day America crosses a frontier—the frontier of a new market. It is the market created by an ever growing population. Since Pearl Harbor, our population has increased 23½ millions—more than all the people now living in the region west of the Mississippi once called the Louisiana purchase, that vast billion-acre area which provided us with geographical frontiers for a hundred years.

During 1952, 8,500 babies were born daily, increasing our population by nearly 3,000,000 people. New families and bigger families need more and bigger houses, more food, clothing, cars, roads, hospitals, churches, schools. Their needs call for continuing and increasing production from farms and factories.

There are those among us who say a decline in government spending will bring depression. But where is there room for depression when we add the population of another Minnesota or an Iowa to our nation each year—when the need for goods and services increases steadily? In fact, only by tapering off our vast programs of government spending can industry and business hope to provide sufficient goods to maintain our present standard of living and satisfy the demands of our ever growing population.

Let no one tell you America has crossed its last frontier.

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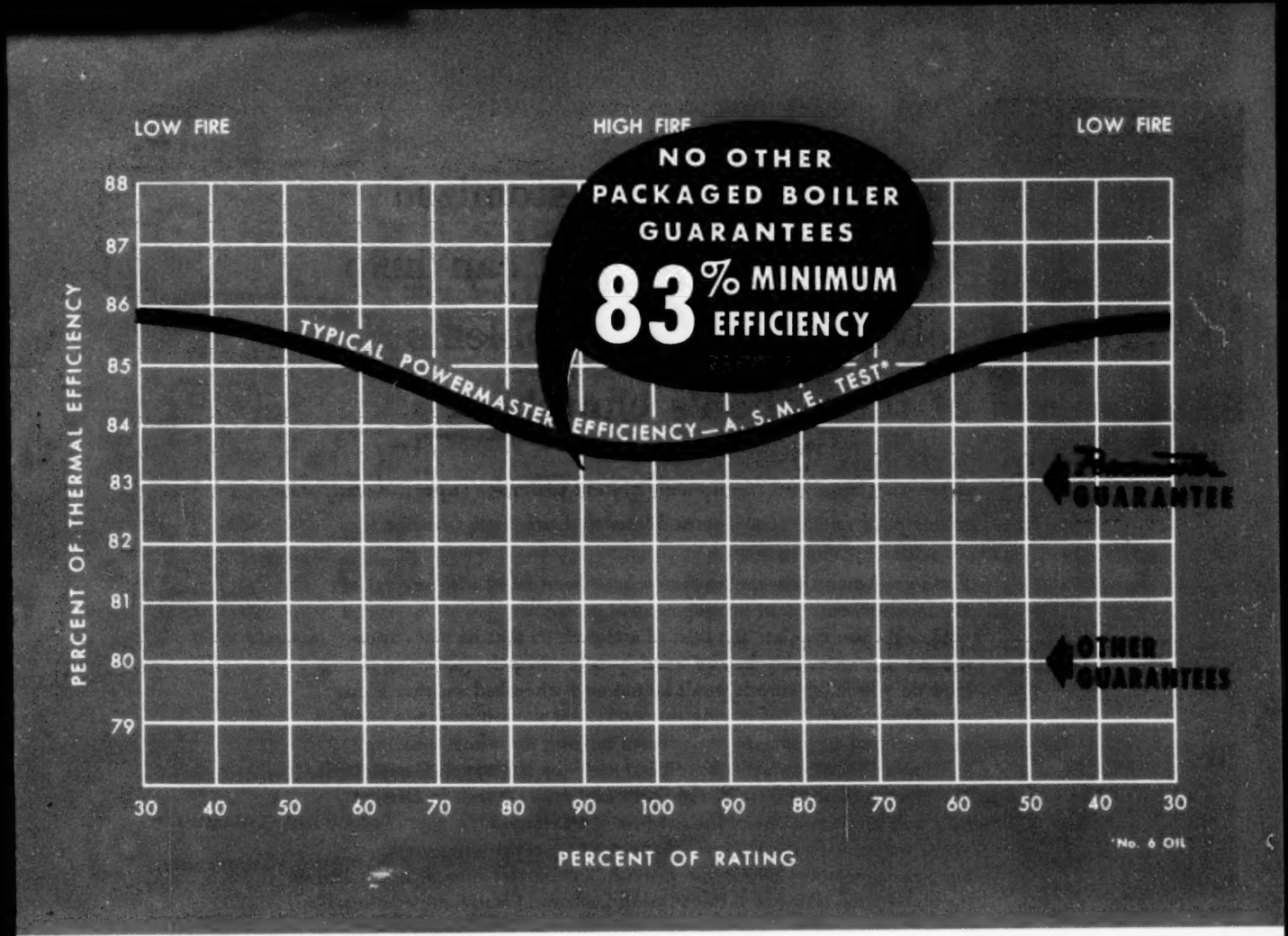
MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

RAILROAD TRACK SPIKES - CONDUIT - HOT AND COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - RODS - SHEETS - PLATES.



Only Powermaster guarantees 83%!

The "pay-off" on a boiler is its operating efficiency!

Take a look at this typical efficiency curve of POWERMASTER . . . then compare A.S.M.E. tests with those of any other boiler! At less than full load (which is normal in field operation) notice that POWERMASTER efficiency actually *increases.*

There's a reason for such efficiency. The POWERMASTER is the development of 68 years' experience in boiler manufacture. Continuing research and progressive engineering have consistently been reflected in POWERMASTER design:

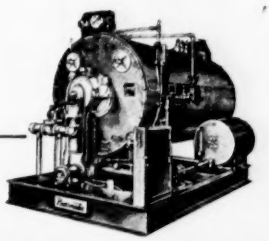
- **FIRST to provide the Voriflow air-atomizing burner.**
- **FIRST to provide full modulating cam control.**
- **FIRST to provide immediate change-over from oil to gas firing.**
- **FIRST to provide a *complete* packaged unit.**

Point-by-point, POWERMASTER welcomes comparison. Before deciding on a new boiler for your plant, be sure to get the facts on the new POWERMASTER with VORIFLOW combustion. Just drop us a line and we'll be glad to send you complete information.

Powermaster®

PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.



ORR & SEMBOWER, INC. • *Established 1885* • 980 MORGANTOWN ROAD, READING, PENNA.

How Honeywell Customized Temperature Control can help solve the heating problems of the nation's churches

Specially designed Honeywell system provides superior comfort, saves fuel in Denver's new Messiah Lutheran Church

For a good many years, churchmen have been faced with several of the most difficult of all heating control problems.

How do you regulate the heat of a church so that its main areas are not uncomfortably hot on worship days when the gathering is large? How do you make sure it won't be too cold when bad weather keeps attendance down? And during the week, how do you maintain comfort in offices and auxiliary rooms without heating the whole building?

The way these problems have been met—by Honeywell Customized Temperature Control—in the Messiah Lutheran Church in Denver may well serve as a model for the rest of the nation.

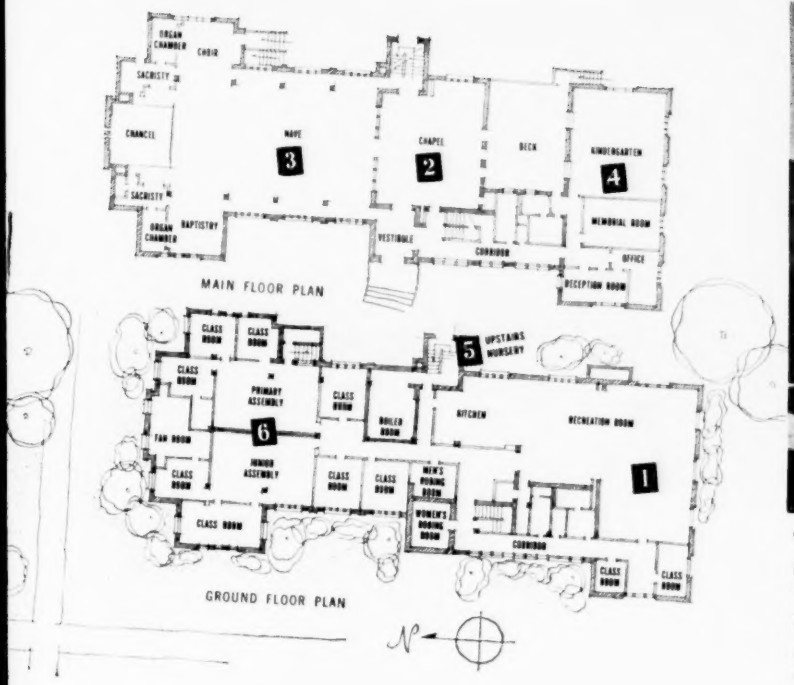
For today, with ten Honeywell thermostats controlling seven temperature control zones, (the seventh, a perimeter zone, is not shown on the floor plan), all areas of the Messiah Lutheran Church are comfortable all the time. And fuel consumption is held at an economical level.

Six thermostats control comfort in two zones of nave

The area embracing the altar, choir section, and front portion of the nave proper is included in one zone. Here one thermostat controls the radiant floor panel while two others, on either side of the altar, control the heating and ventilating system discharging at the grilles shown in the ceiling. The rear part of the nave and the chapel are controlled as a separate zone. Also in this area, two special electric thermostats regulate the temperature of the organ pipes in each organ chamber to guarantee proper tuning.

Architect:
Raymond Harry Ervin, Denver

Mechanical Engineers:
Marshall & Johnson, Denver



This photo of the exterior of the Messiah Lutheran Church gives a good idea of the clean architectural lines of the building, which was designed by Denver architect Raymond Harry Ervin. Also, it shows the wide variety of weather exposures of the structure. But Honeywell Customized Temperature Control as easily compensates for strong northern winds as it does for sunshine on a bright winter day.

For comfortable, even temperature in new or existing buildings—of any size—specify Honeywell Customized Temperature Control

Whether it's a church, school, office, factory, hospital, apartment, store, garage—or any size building—new or existing, Honeywell Customized Temperature Control can help meet your clients' heating, ventilating, air conditioning and industrial control problems.

Once equipped with Honeywell Customized Temperature Control, they'll have an ideal indoor "climate"—and save fuel besides.

And with a complete line of pneumatic, electric and electronic controls to choose from, Honeywell Customized Temperature Control offers you the greatest flexibility in design. Then, too, when it comes to performance, Honeywell-built controls assure years of trouble-free operation. And they're backed by the finest service organization in the controls industry.

For information on Honeywell Customized Temperature Control, call your local Honeywell office. There are 104 across the nation. Or mail the coupon today.

MINNEAPOLIS
Honeywell

First in Controls

And this view of the upstairs nursery shows how well the younger set fares at the Messiah Lutheran Church. A separate Honeywell thermostat here can be adjusted to compensate for weather conditions and the number of children in attendance. Temperatures are usually kept warmer here—a turn of the dial on the thermostat takes care of that—so youngsters won't be exposed to drafts on the floor.

MINNEAPOLIS-HONEYWELL REGULATOR CO.
Dept. HV-3-45, Minneapolis 8, Minnesota

Gentlemen:
I'm interested in learning more about Honeywell Customized Temperature Control.

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You can put full confidence in them!

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HEATING
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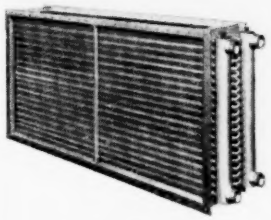
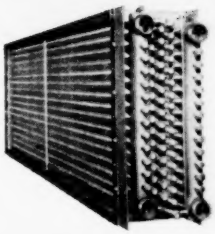
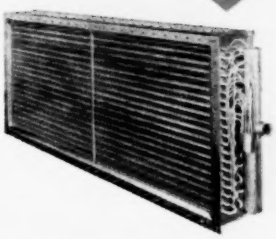
THIS COMPLETE LINE OF FAMOUS McQuay PRODUCTS



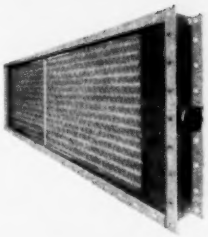
WATER COIL



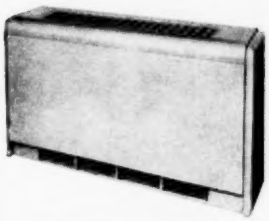
CLEANABLE TUBE WATER COIL



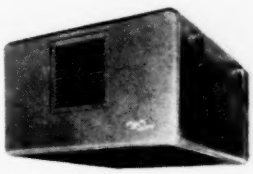
DIRECT EXPANSION COIL



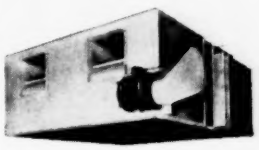
"BLAST" HEATING STEAM COIL



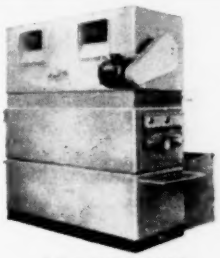
SEASONMAKER (FLOOR)



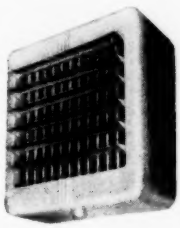
"RH" AIR CONDITIONER



AIR CONDITIONER
(Suspended Model)



AIR CONDITIONER
(Floor Model)



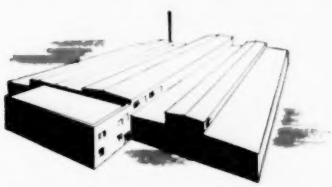
HORIZONTAL UNIT HEATER

DOWN FLOW UNIT HEATER

BLOWER TYPE UNIT HEATER
(Suspended Model)

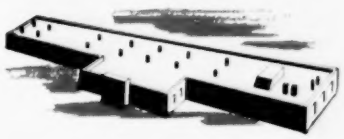
BLOWER TYPE UNIT HEATER
(Floor Model)

McQuay representatives, in all principal cities throughout the United States, are qualified by long experience and training to help you satisfy all of your air conditioning and heating requirements. For cooperation in making the sale, technical advice, or getting the job done on time, consult the McQuay representative in your territory. Available to you through him is the complete line of McQuay products, featuring famous Ripple-Fin construction—a McQuay exclusive, assuring maximum heat transfer efficiency and dependable performance.



PLANT 1—1600 Broadway N. E.
MINNEAPOLIS 13, MINN.

PLANT 2—1729 Broadway N. E.
MINNEAPOLIS 13, MINN.



PLANT 3—4th and Park Ave.
FARIBAULT, MINN.

THE PICK OF THE PACKERS

Out where the West *ends* . . . many of the great meat packers use Worthington *refrigeration* machinery.

And all over the country, many famous *restaurants*—Toffenetti's in Times Square, Silver Fox Restaurant in Washington, The Century Room, Dallas—use Worthington *air conditioning machinery*.

When you specify "Worthington", you specify the air conditioning and refrigeration equipment that's used by the "first" names in every field.

No other manufacturer makes *so complete* a line. A Worthington system is all Worthington-*made*—not just Worthington-assembled—assuring you of perfectly balanced operation and unit responsibility.

Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, New Jersey.

America's Leader's... in Many Businesses... Select

WORTHINGTON

A.2.11

AIR CONDITIONING AND REFRIGERATION

The Most Complete Line... Always the Correct Recommendation

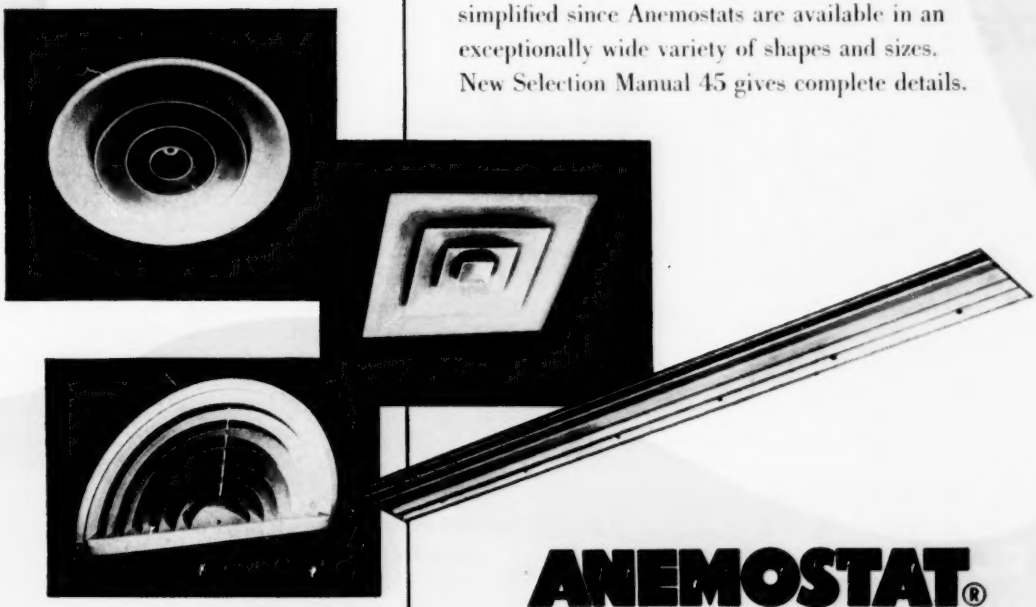
For top performance

THERE IS NO "OR EQUAL"

When you specify Anemostat Air Diffusers there is no "or equal."

Top Performance is not an accident. Anemostat Corporation of America has pioneered the manufacture of quality air diffusers, has established standards to assure proper air distribution, and diligently continues research and development for the benefit of the industry which it serves.

Since no air conditioning system is better than its air distribution, it is important to make sure that you provide draftless conditions with Anemostat *aspirating* air diffusers. Design problems are greatly simplified since Anemostats are available in an exceptionally wide variety of shapes and sizes. New Selection Manual 45 gives complete details.



ANEMOSTAT®

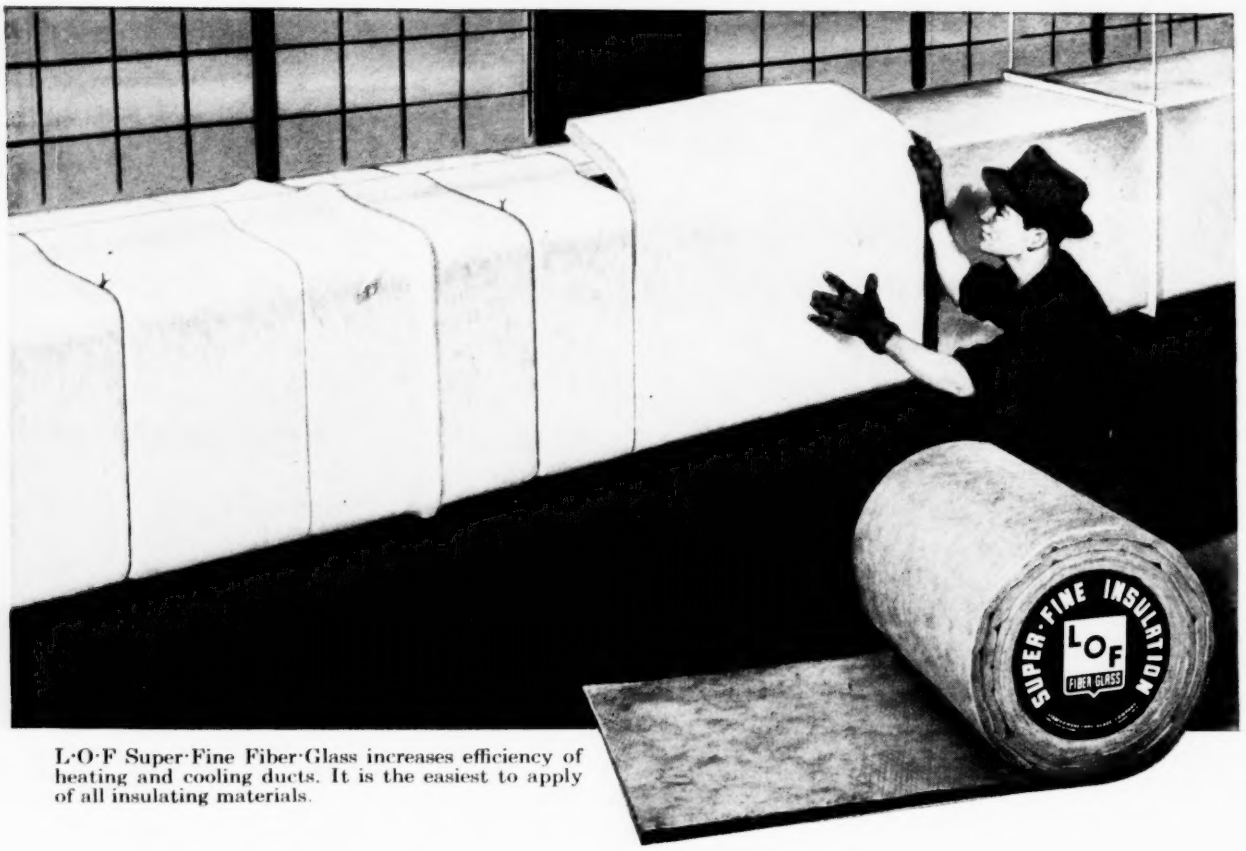
DRAFTLESS *Aspirating* AIR DIFFUSERS

ANEMOSTAT CORPORATION OF AMERICA

10 EAST 39th STREET, NEW YORK 16, N. Y.

REPRESENTATIVES IN PRINCIPAL CITIES

"No Air Conditioning System Is Better Than Its Air Distribution"



L·O·F Super·Fine Fiber·Glass increases efficiency of heating and cooling ducts. It is the easiest to apply of all insulating materials.

Boost efficiency of your duct installations with L·O·F Fiber·Glass

Increase the over-all efficiency of your cooling and heating duct installations with L·O·F Super·Fine Fiber·Glass insulation. These lightweight blankets surpass other types of fibrous insulation for resistance to heat flow.

As heating duct insulation, Super·Fine Fiber·Glass reduces heat losses and saves fuel. On cooling ducts it saves power and permits use of smaller units. Applied to the inside of either type duct, coated L·O·F Super·Fine Fiber·Glass muffles noise. It reduces condensation on air conditioning ducts and the glass fibers will not absorb moisture. Super·Fine Fiber·Glass can be used for temperature ranges from sub-zero to 400 degrees F.

Super·Fine Fiber·Glass is lightweight and is easily fabricated and installed by one man. It requires no pre-processing to various diameters and shapes. Super·Fine takes the conformation desired as it is installed. It can be applied to either round or rectangular ducts and adds very little weight to the installation.

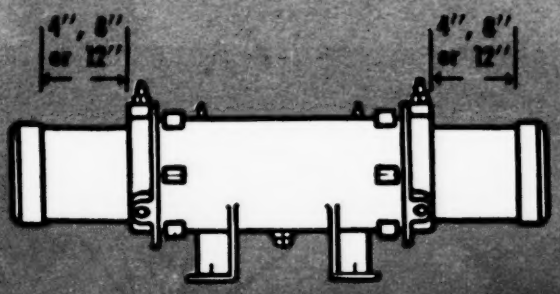
For more information contact the nearest L·O·F office (offices in 26 major cities). Or write Libbey·Owens·Ford, Dept. F·G 3133, Wayne Building, Toledo 3, Ohio.

LIBBEY·OWENS·FORD GLASS COMPANY
FIBER·GLASS DIVISION

L OF GLASS PLASKON FIBER·GLASS

FIBER·GLASS

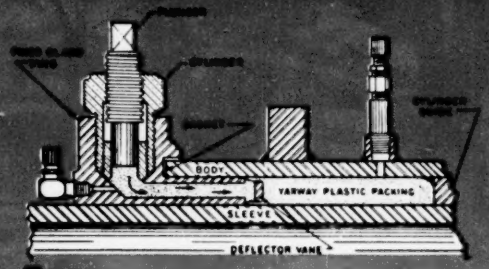
YOU NEED FEWER JOINTS



With Yarway Gun-Pakt slip-type expansion joints you need fewer joints than with other types, because each sliding sleeve has a traverse of 4", 8" or 12" . . . maximum expansion being 24" for a double-end joint.

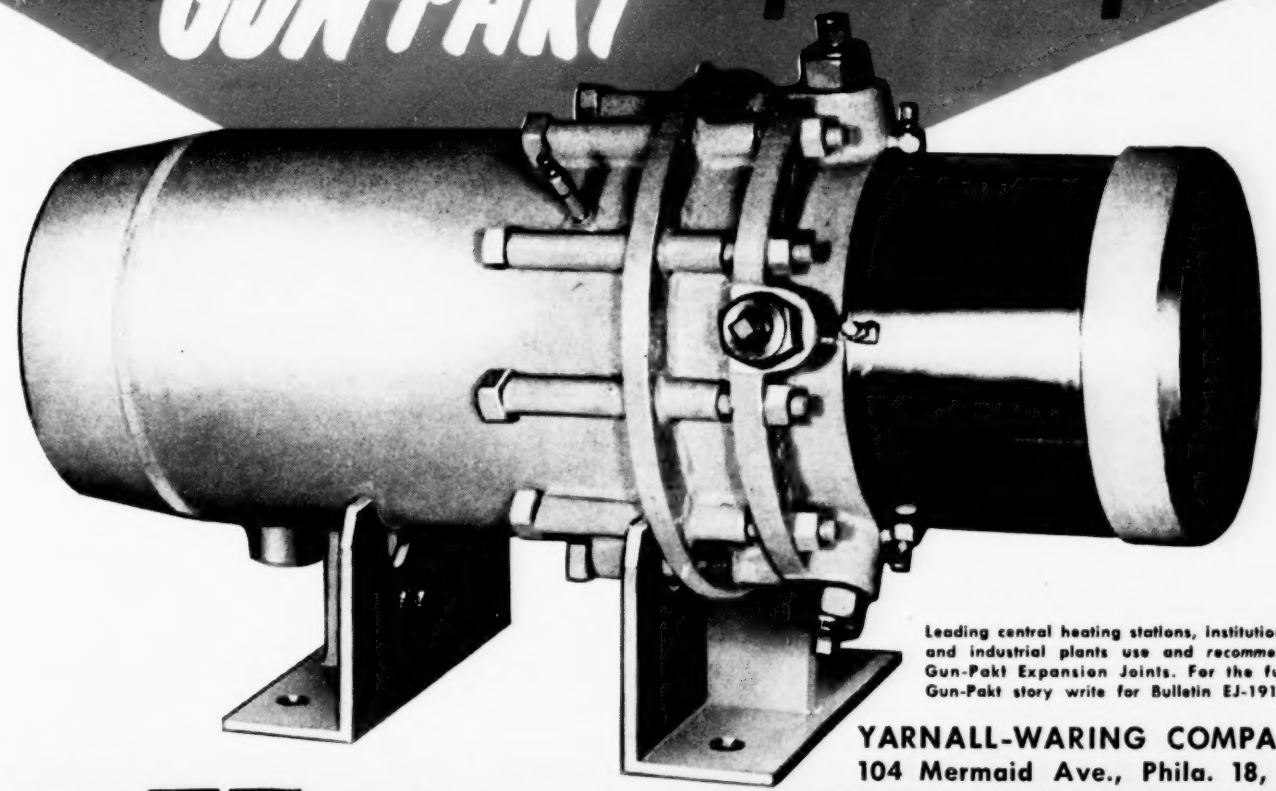
For example, one single-end Yarway Gun-Pakt joint with an 8" traverse is all that is needed for a 200 ft. run of steel pipe carrying saturated steam at 350 psi.

AND LESS MAINTENANCE



No need for shutdowns. Yarway Gun-Pakt Joints are serviced under full steam pressure. Just insert a plug of Yarway plastic packing, twist a wrench and the job is done. Maintenance and production manhours are saved!

with GUN-PAKT expansion joints

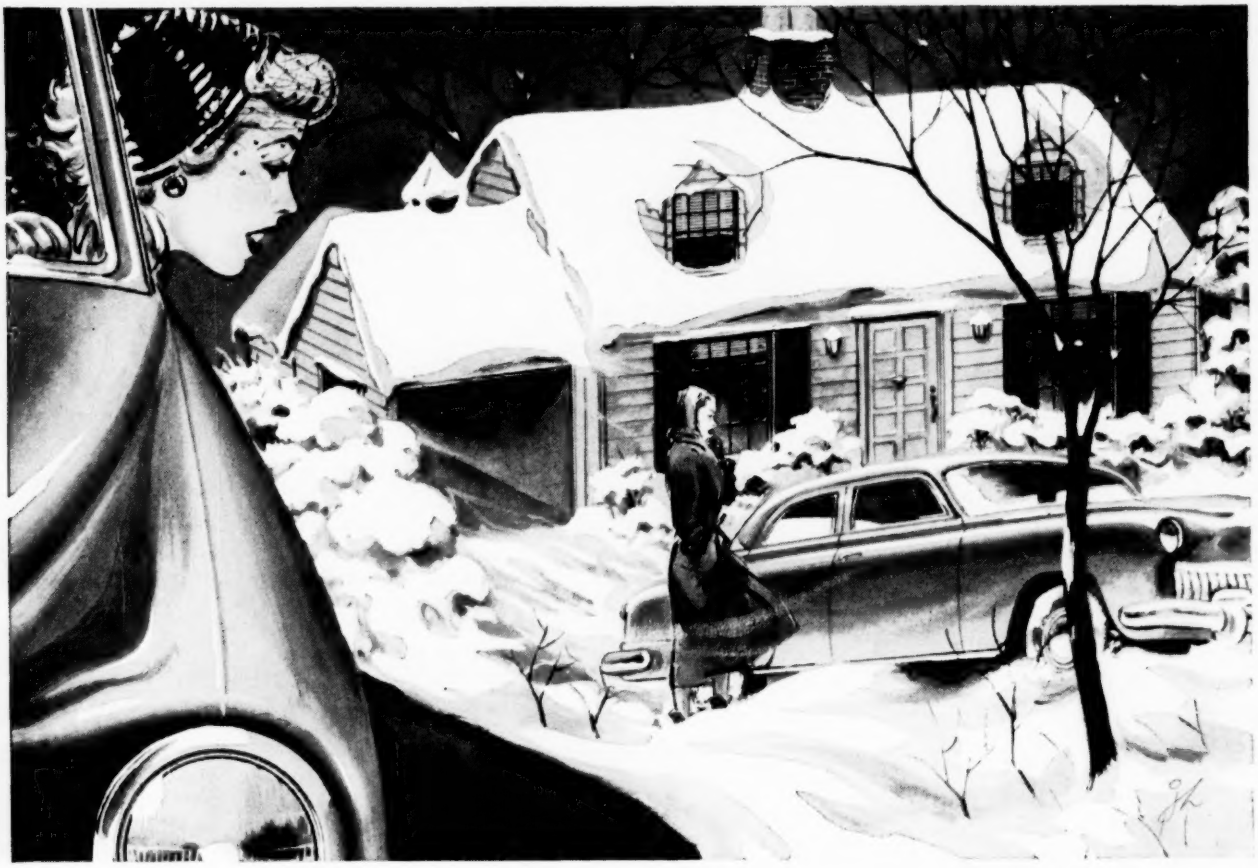


Leading central heating stations, institutions and industrial plants use and *recommend* Gun-Pakt Expansion Joints. For the full Gun-Pakt story write for Bulletin EJ-1912.

YARNALL-WARING COMPANY
104 Mermaid Ave., Phila. 18, Pa.

YARWAY GUN-PAKT EXPANSION JOINT

"What a shame!... they don't have snow melting"

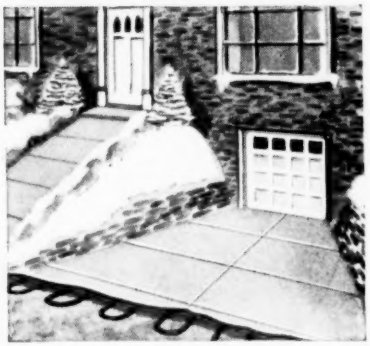


As she looks at her neighbor's plight, the woman next door can thank her lucky stars that *she* insisted on driveway snow melting. She knew the dependence of modern suburban dwellers on the family car . . . for transportation to and from work, for shopping, visiting, church going, and for emergencies!

Suburban living can be wonderful in fine weather, but when snow or ice hits, a car can be tied up tight in the owner's driveway or garage approach, even though the streets and roads have been cleared.

So, more and more, home owners are installing driveway and sidewalk snow melting systems. They consider it a sound investment, for in addition to assuring mobility at all times, it eliminates snow removal expense, spares the human back, and adds appreciably to property value.

You can be sure when you specify steel pipe, that it is the *first choice* for such installations. Its known economy, proved durability in over 60 years of hot water and steam heating applications, formability and weldability for coils and grids, make it a natural selection. In fact, for snow melting, radiant heating, conventional heating and other uses, steel is the most widely used pipe in the world!



With a driveway snow melting system the family car is always instantly available for pleasure, business, or emergency use. Steel pipe snow melting keeps Americans mobile!

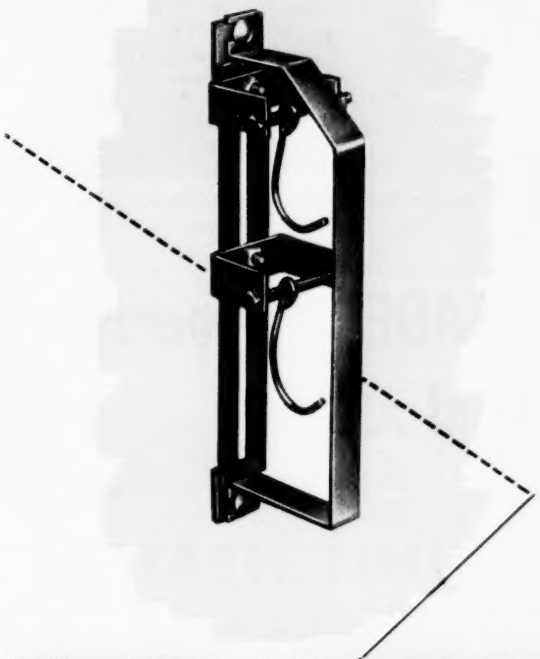
Steel Pipe is First Choice

COMMITTEE ON STEEL PIPE RESEARCH

AMERICAN IRON AND STEEL INSTITUTE

350 Fifth Avenue, New York 1, N.Y.

Bush heating installation...a pipe"



Bush FINNED *pipe, that is! . . . at new Remington Rand Building in Hartford, Conn.*

Contractors praise Bush finned pipe . . . say it's easiest to install of any type of finned radiation. Expansion hangers are the answer.

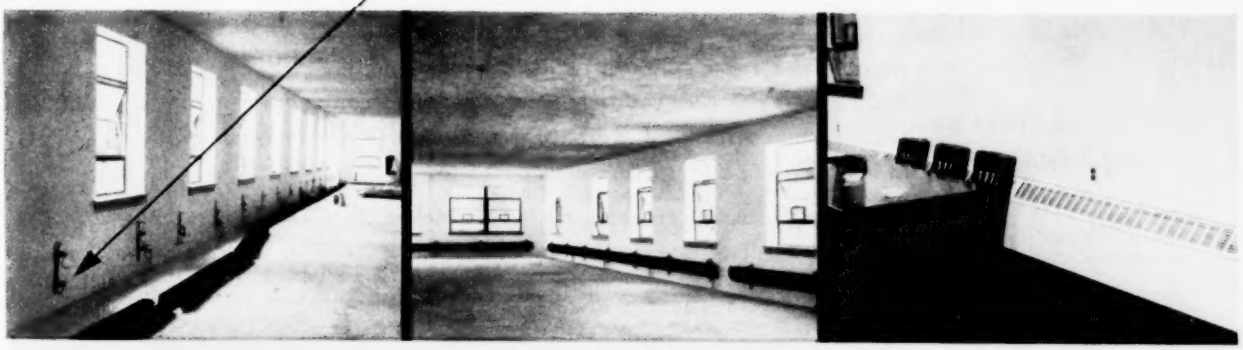
Bush expansion hangers . . . simple, efficient, practical. Attached to the wall with 2 bolts, these adjustable pipe hangers provide for a full 3" of horizontal expansion as well as 2" of pitching. Moreover, the complete assembly is designed to serve as support for the cover.

At Remington Rand's new office building in Hartford, the heat load for the 72' x 128' two story building is handled by two boilers — each with a capacity of 4480 sq. ft. of radiation. Continuous flow control — actuated by an indoor-outdoor thermometer — regulates the water temperature.

Bush type W finned radiation (4" x 4" on 2" pipe) has been used throughout. Bush covers provide the finishing touch to a modern, easily installed commercial heating system.

Check with a Bush Engineer the next time you're on an institutional, commercial or industrial heating job . . . make your task a "pipe".

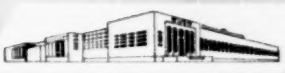
Write for free bulletins on Bush finned radiation and covers.

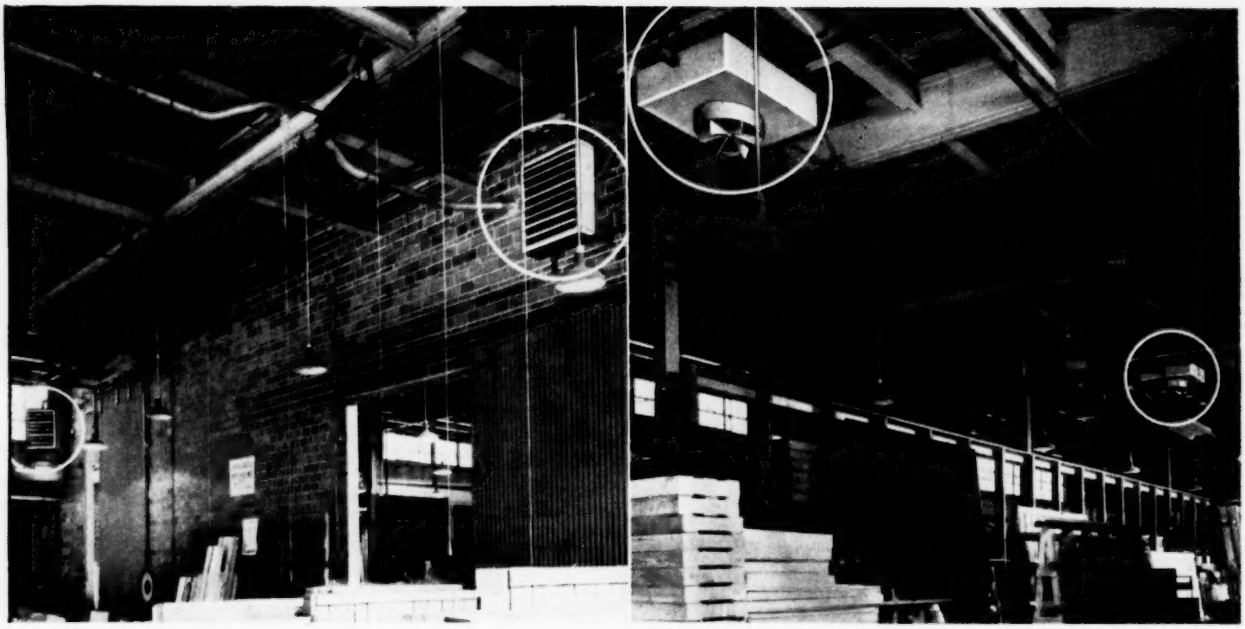


Architect: Frederick C. Teich; Hartford, Conn.
Contractor: Morris A. Fierberg Co.; Hartford, Conn.
Engineers: Hurley and Capacefalo; Winstead, Conn.

BUSH MANUFACTURING COMPANY

WEST HARTFORD 10, CONNECTICUT





AIRTHERM Horizontal Discharge Unit Heaters installed on the loading platform of Pittsburgh Plate Glass Company.

AIRTHERM Vertical Discharge Unit Heaters installed in the Pittsburgh Plate Glass Company warehouse.

For "TAILOR MADE" Temperature In Every Department...

Airtherm STEAM UNIT HEATERS

Were Chosen for PITTSBURGH PLATE GLASS CO.

ST. LOUIS, MISSOURI

Here's another example of how the complete line of AIRTHERM Steam Unit Heaters can give you truly *flexible heating* to meet the many different requirements in factories, warehouses, garages, super markets, schools, offices, bowling alleys and similar buildings.

Architect:
A. Stanley Knorth & Associates

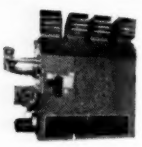
General Contractor:
Woermann Construction Company

Heating and Air Conditioning Contractor:
Sodemann Heat and Power Company

Consulting Engineers:
Ferris & Hamig

Horizontal Discharge Heaters are built in eleven standard and eleven low outlet temperature models, in capacities from 18,600 BTU to 270,000 BTU.

Vertical Discharge Heaters are built in seven standard and seven low outlet temperature models, in capacities from 32,300 BTU to 350,000 BTU.



Oil or Gas Direct Fired Heaters

Convectors

Centrifugal Fan Type Unit Heaters

Write for Catalog 1209.

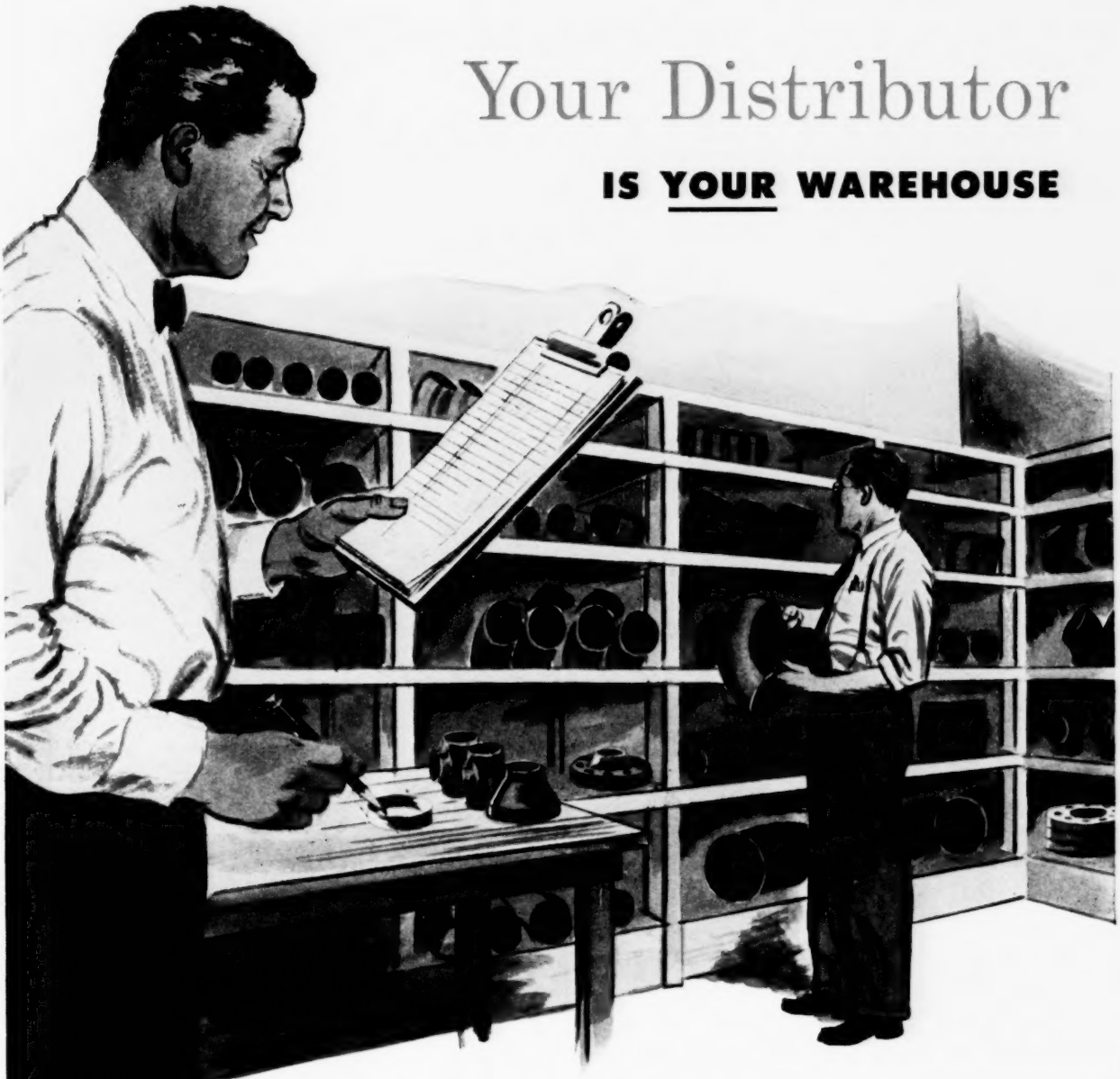
Ask your Wholesaler for Airtherm Unit Heaters.

Airtherm **MANUFACTURING COMPANY**

722 SOUTH SPRING AVENUE • ST. LOUIS 10, MISSOURI

Your Distributor

IS YOUR WAREHOUSE



ONE of your TUBE TURNS' Distributor's prime functions is to maintain local stocks of equipment and supplies. In effect, he acts as your warehouse—permitting you to operate with reduced inventories, and to move quickly to meet changing production needs.

TUBE TURNS' Distributors and TUBE TURNS, INC., are a service-minded team. Call your nearby TUBE TURNS' Distributors for good service in good connections—it will help you with your inventory and supply operations.

tt TUBE-TURN TRADE MARK

"tt" and "TUBE-TURN" Reg. U.S. Pat. Off.

The Leading Manufacturer of Welding Fittings and Flanges

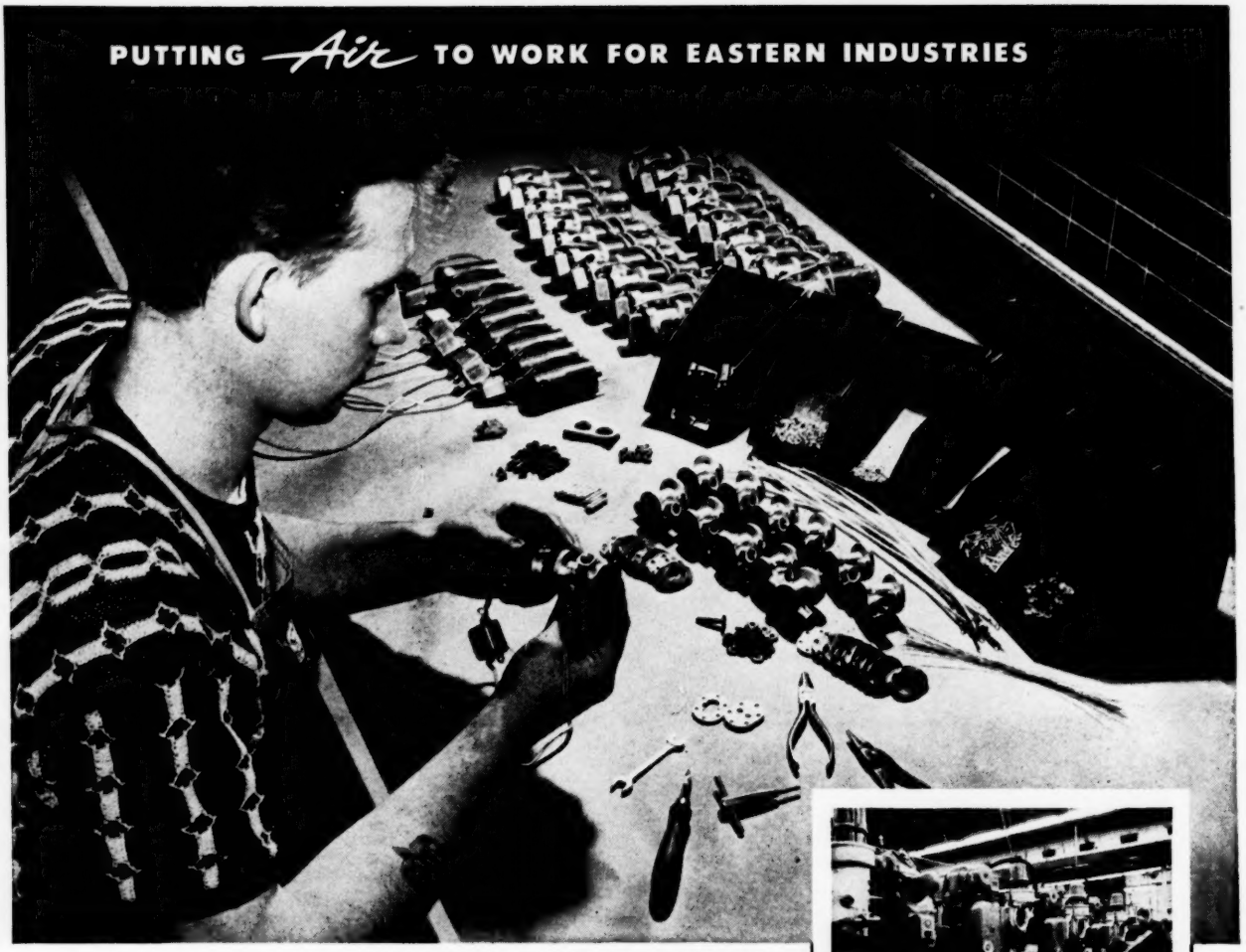
TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles

Subsidiaries: TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO

PENNSYLVANIA FORGE CORPORATION, PHILADELPHIA, PA. • KEROTEST MANUFACTURING COMPANY, PITTSBURGH, PA.

PUTTING *Air* TO WORK FOR EASTERN INDUSTRIES



Machined surfaces flat to one light band—that's one-millionth of an inch —are made possible the year 'round by Westinghouse air conditioning.

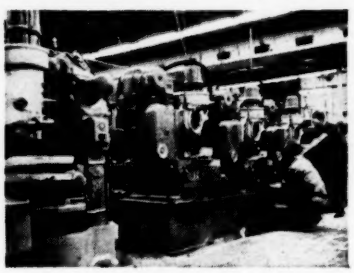
CONDITIONED AIR

HELPS WIPE A WINDSHIELD AT 30,000 FEET

This midget motor-pump sprays a grease-removing solvent onto aircraft windshields. Another provides ground-level conditions for air-borne radar in the stratosphere. Eastern Industries *mass produces* both, but with *tool-room precision.* Critical dimensions are held to plus or minus 25 millionths of an inch! That just isn't possible in hot, humid air.

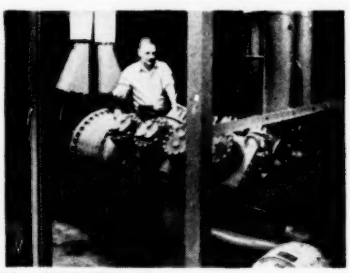
The answer? Westinghouse-conditioned air maintains plant-wide, controlled atmosphere for such exacting machining, assembling, testing and inspecting. Air conditioning and air cleaning assure a constant temperature and humidity the year 'round, help guard against the dirt, rust and corrosion that will upset delicate gauges or mar super-finished surfaces.

Your product, processes and employees will do better in Westinghouse engineered air. Let us help you *put air to work* for more production, higher quality or improved methods. Check the Yellow Pages for your local Westinghouse Air Conditioning Distributor, or write Westinghouse Electric Corp., Air Conditioning Division, Hyde Park, Boston 36, Massachusetts.



Ducts supply entire building with conditioned air for precision work like this gear cutting operation.

This electronic gauge is so sensitive that even your body heat can cause deflections in its readings.



Their 100 hp Westinghouse compressor is as foolproof as your refrigerator, will give years of service.

YOU CAN BE SURE...IF IT'S

Westinghouse

AIR CONDITIONING

Chicago PUMPS

ARE BETTER PUMPS FOR EVERY BUILDING SERVICE

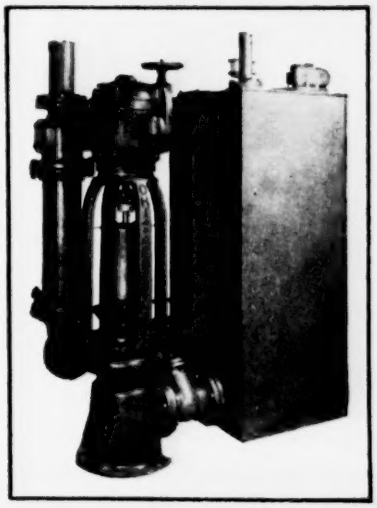
BILGE PUMPS AND SEWAGE EJECTORS

For reliable heavy duty service engineers consistently specify CHICAGO Bilge Pumps and Sewage Ejectors. Bilge pumps from 1¼" to 8" with capacities from 5 to 5000 G.P.M. Sewage Ejectors from 3" to 8" with capacities from 50 to 5000 G.P.M. In addition to the pumps illustrated, dry pit open shaft pumps are also available. All closed shaft pumps have an intermediate guide bearing for every 3 to 4 ft. of shaft, depending on the pump length. The upper thrust bearing is located well above the floor level. Tongue and groove construction throughout insures accurate alignment.

CHICAGO INDUSTRIAL PUMPS

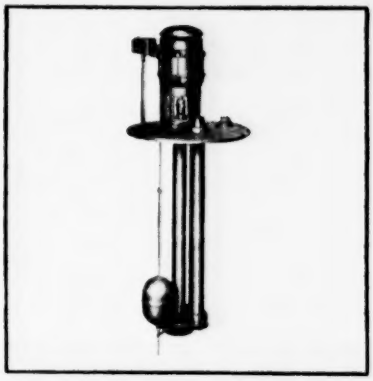
FLUSH-KLEEN SEWAGE EJECTOR TYPE S

The only positively clog-proof sewage ejector. Flush-Kleens are furnished as a complete package, as illustrated, or in duplex for submerged or dry well installations. Described in Bulletins 122-C, 122-S.



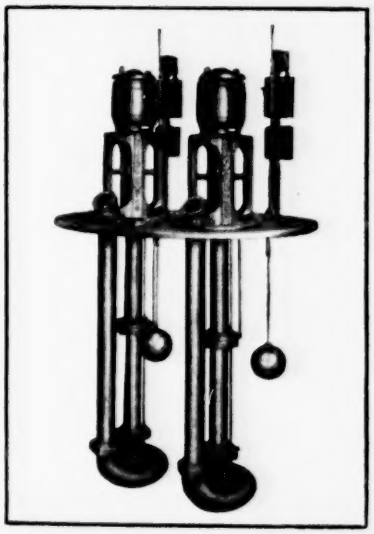
TYPE LG12 AUTOMATIC ELECTRIC BILGE PUMP

Specifically designed to drain basements, pits and sumps. Centrifugal volute pump with open bronze impeller. A cast iron strainer of large area surrounds the suction opening. Described in Bulletin 118.



DUPLEX VERTICAL CLOSED SHAFT NON-CLOG PUMPS

These pumps are suitable for either bilge or sewage service. Complete control equipment is mounted on the basin cover. Each pump is mounted on separate floor plate to allow easy removal of either pump for servicing. Described in Bulletin 124.



CHICAGO PUMP COMPANY

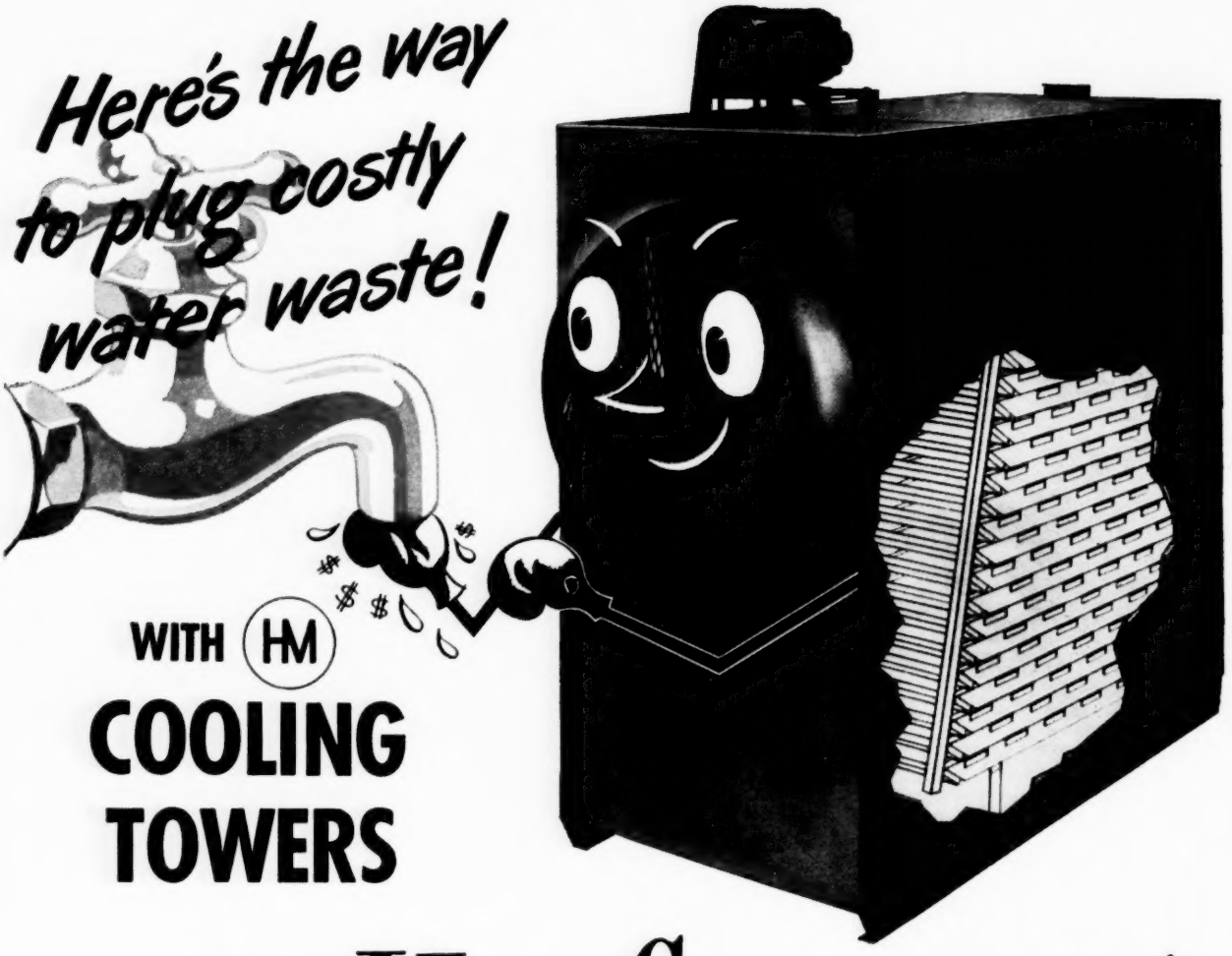
BUILDING and INDUSTRIAL DIVISION

622 DIVERSEY PARKWAY — CHICAGO 14, ILLINOIS

Condo-Vac, Sure Return, AVC, LVC, Fire, House & Circulating Pumps, Pneumatic & Tankless Water Systems.

Flush-Kleen Sewage Ejectors, Little Giant & Non-Clog Bilge Pumps for every industrial use.

Here's the way to plug costly water waste!



WITH HM COOLING TOWERS

20-Year Guarantee!

ON THE WETTED DECK SURFACE

BATTLESHIP STRENGTH!

HOUSING—
Of heavy 10 gauge (1/8"+) sheet steel, with three coats of Bitumastic lining, and four coats of outside special weatherproof paint. Electrically welded cabinet.

FAN & DRIVE—
Quiet hi-pressure 8-bladed Stainless Steel fan, stainless steel shaft, chrome-dipped rust-proofed pulleys, ball-bearing grease-sealed fan bearings.

Capacity range: 2 Thru 100 Tons

CARRIED IN STOCK BY LEADING WHOLESALERS EVERYWHERE

Send for Literature and Prices

Here's the economy way to water savings—20 years of foolproof performance in an all-around, efficient, economical and lastworthy cooling tower. The processed wetted deck surface in these quality Halstead & Mitchell cooling towers is chemically treated with special Koppers wood—guaranteed 20 years against rotting, and proofed against fungi growth. Gravity-type distributing pan eliminates extra pumping head required on spray-type towers, and cuts down windage losses due to atomizing of water. And, it's easily cleaned—accessible through inlet air side of tower.

HM Halstead & Mitchell

OFFICES: BESSEMER BUILDING • PITTSBURGH 22, PA.

LADISH

Controlled Quality

PIPE FITTINGS

offer dependability safeguarded by advanced metallurgy

Year after year . . . in all kinds of service . . . Ladish Controlled Quality Fittings set new standards of reliability. One reason is the strong reliance on technical progress. Every new facility and advanced technique of modern metallurgy is fully utilized to develop desirable physical properties to maximum limits . . . while unrelenting test procedures continuously safeguard metallurgical soundness and provide users with authentic data proving the complete dependability of every Ladish Fitting.

TO MARK PROGRESS

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF . . . ONE RESPONSIBILITY

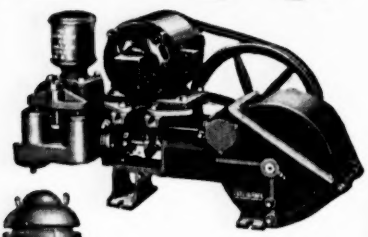
LADISH CO.

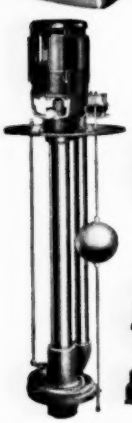
CUDAHY, WISCONSIN
MILWAUKEE SUBURB

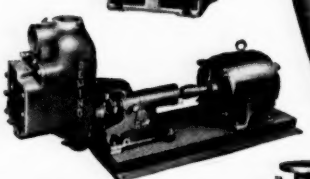
District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • San Francisco • Havana • Mexico City • Brantford, Ont.

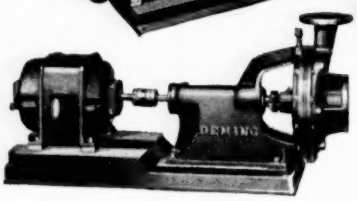
DEMING PUMPS

MORE THAN 1000 *Types and Sizes* FOR YOUR SELECTION









The complete Deming line offers industrial users of pumping equipment more than 1000 types and sizes of units for selection . . . or more than 10,000 if you include the full ranges of capacities, heads, types of mountings and power drives.

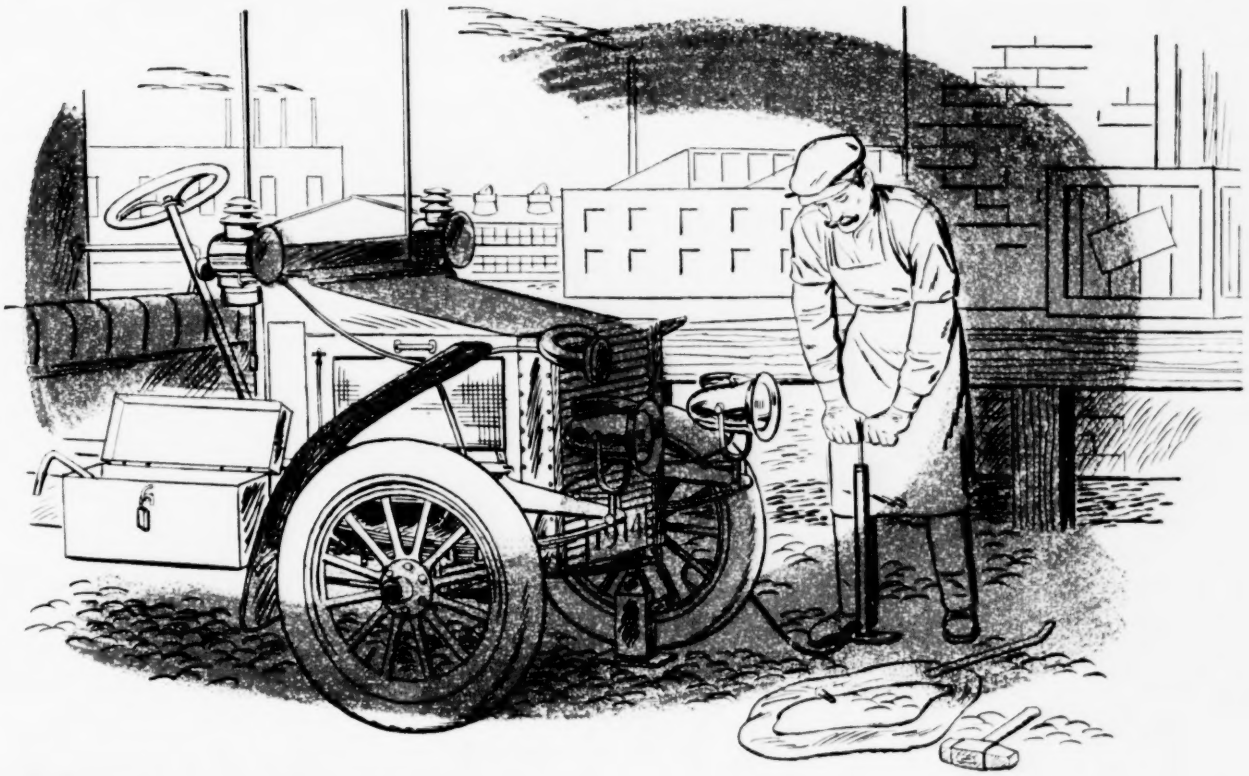
Catalog bulletins on all types of Deming Pumps are available upon request. It will be a pleasure to work with you in the selection of the most efficient pumping units for specific job requirements.

DEMING DISTRIBUTORS LOCATED EVERYWHERE

Close cooperation between Deming field engineers and Deming Distributors makes a hard-to-beat combination of sales-engineering "know-how" to serve your pumping needs. If you don't know where to locate the nearest Deming Distributor, write us.

THE DEMING COMPANY

558 BROADWAY • SALEM, OHIO



Motor Power...

eliminated the need for this back-bending labor!

Compressed air, used in numerous industrial applications to lift, move, clean and spray, also provides the riding cushion for millions of vehicles.

Powerful, efficient compressors, equipped with specially adapted motors, make this commodity an important and useful tool for industry. Car-owning families are patrons of "free-air" service, made available through America's 190,000 filling stations, thanks to that same number of dependable air compressors.

Emerson-Electric Motors were first used on air compressors in 1899, and the progress of the industry has been matched with improvements in the motor drives.

Emerson-Electric builds dependable, efficient motors for equipment used in industry, in business, on the farm and in the home. There is a complete line of Emerson-Electric standard motors in horsepower ratings from 1/20 to 5, and hermetic motor parts in ratings from 1/8 to 15 horsepower. Your inquiry is invited.

The EMERSON ELECTRIC Mfg. Co., St. Louis 21, Mo.

MODERN INDUSTRY **IS POWERED WITH** ELECTRIC MOTORS

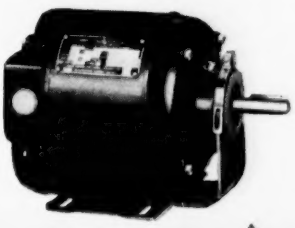
EMERSON-ELECTRIC'S unique

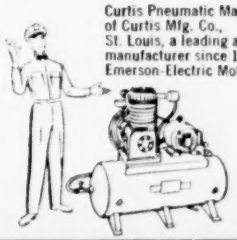
Twin-gineering

SERVICE

solves your power problems

Our engineers are eager to work with yours in designing and providing the correct motor for contemplated new or improved appliances or equipment. "TWIN-GINEERING" saves costly engineering "back-tracking," and may suggest short cuts and product improvement. Write today for Bulletin No. M177.





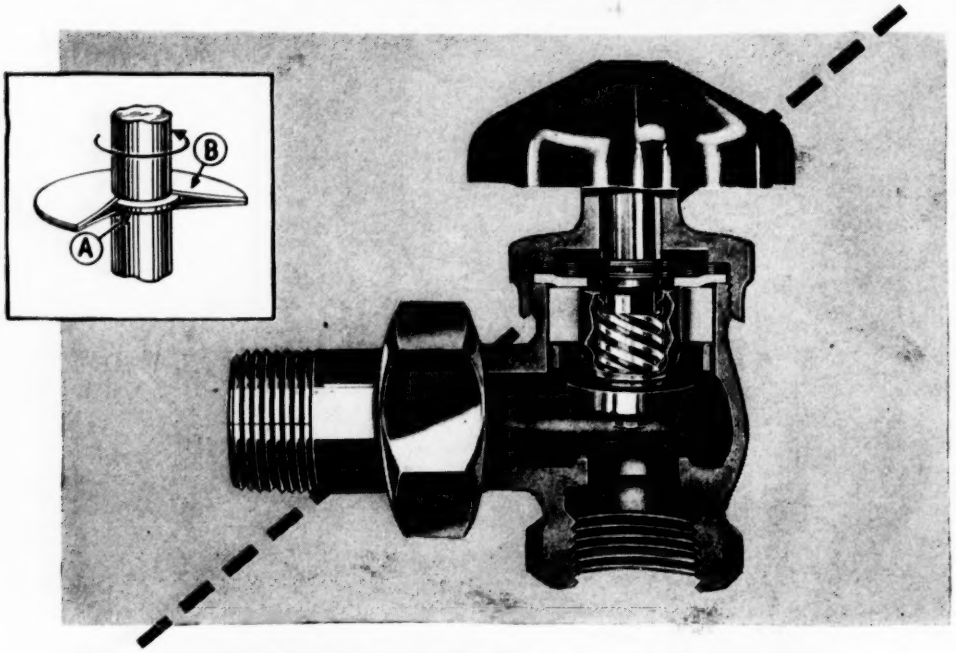
Curtis Pneumatic Mach'y Div. of Curtis Mfg. Co., St. Louis, a leading air compressor manufacturer since 1896, is a user of Emerson-Electric Motors.

EMERSON ELECTRIC

MOTORS • FANS APPLIANCES

LEADERS IN THE MOTOR AND FAN INDUSTRY SINCE 1890

A Valve that is



PACKLESS in fact

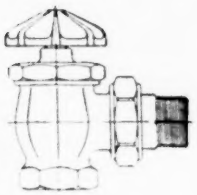
. . . not just packless in name

When the job calls for the kind of valve that will stand up across the years —when it calls for a valve that is packless in the full meaning of the word— then, no matter how far you look, you'll find in the Marsh Packless the only valve that completely fills the bill.

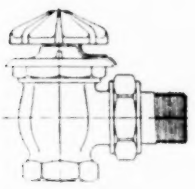
In fact, many users consider this the only valve that is packless in fact as well as in name, and they have a good reason for this. There is a difference between pack less and packless! The diagram tells the story of Marsh truly packless construction. A collar (A) is machined on the valve stem. The stainless spring steel wafers (B) press against this collar to form a tight annular seal This, you see, is a metal-to-metal seal—*permanently* leakproof.

And this better construction is typical of the quality and refinement found throughout the Marsh Packless Valve—in the swivel, self-seating, self-cleaning disc—in the excellent proportioning, machining, workmanship and finish.

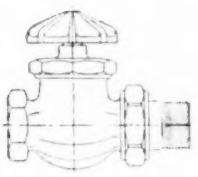
Packed valves can and do "blow out", scalding or burning the operator. This danger is avoided when you use the Marsh Packless. It is a valve you can rely on for any service up to 100 lbs. Furnished in a wide range of patterns including graduated and extended stem types, the Marsh Packless Valve is widely used for steam and hot water heating systems, coffee urns, steam kettles, sterilizers, ovens and similar services. Ask our representative or engineering department for facts.



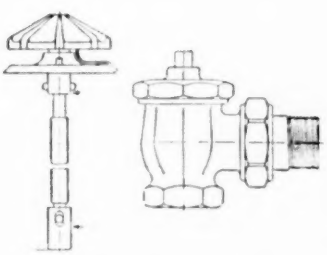
Wheel Angle



Wheel Angle Graduated



Globe



Extension stem

MARSH HEATING EQUIPMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*

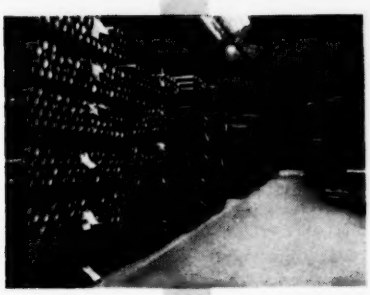
Dept. U, Skokie, Ill.

MANUFACTURERS OF GAUGES • THERMOMETERS • WATER REGULATING VALVES • SOLENOID VALVES

MARSH SINCE 1865

Quality Heating Specialties

HOW DO YOU CHOOSE BETTER BOILER TUBES?



All boiler tubes are made to the same specifications to do the same jobs, no matter what mill supplies them. In the warehouse, they all look pretty much the same. Surface comparison rarely shows the difference. That is because only *time* can truly test the worthiness of a tube in a boiler—time and the ravages of heat, corrosion and oxidation. Look for the answer down in the basements of apartment houses, or hospitals, or schools, or office buildings, or anywhere else you'd expect to find good boilers, made by fine craftsmen, perfo:ming efficient and faithful service over the years. Almost anywhere you look, you'll find the most reliable boilers are equipped with B&W boiler tubes.

Say B&W before you say WELDED BOILER TUBES—for Service-Proved Dependability. For three-quarters of a century, B&W has been directly concerned with developing and applying boiler tubes for pressures approaching 3000 psi. The application of this extensive knowledge and experience results naturally in the production of superior boiler tubes.

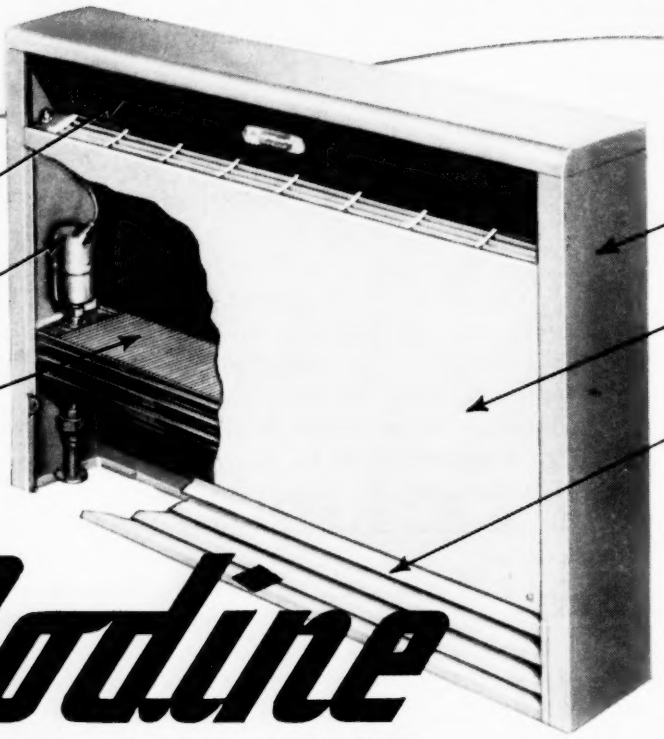
B&W dependability is proved by time and endorsed by hundreds of customers who keep coming back for more . . . B&W WELDED BOILER TUBES.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION

Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

TA-1694C

Plan your heating for the life of the building



Unique damper, for finger-tip temperature control, conceals curved outlet air grille.

Air vent can be conveniently located at either end of outlet grille—instantly accessible.

All steam-carrying passages are copper or copper alloy . . . brazed for pressure-resisting strength.

Steel enclosure is Bonderized for rust protection, built to "take it."

Front panel is quickly removed and replaced by means of two screws for full access to unit.

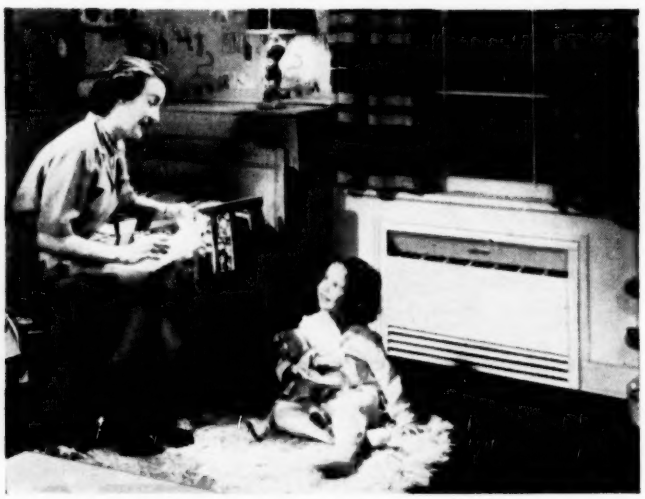
Attractive lower grille (optional) snaps in or out, conceals piping.

Popular Type F illustrated. For exposed or recessed installation. Immediately available from most jobbers' stocks.

Modine

CONVECTOR RADIATION

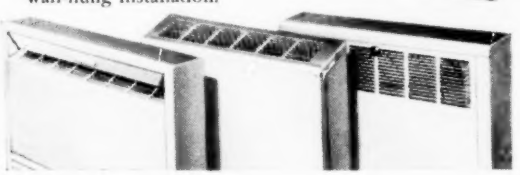
offers the best in long-life, economical service



Simplicity of styling complements the beauty of both modern and traditional design, also promotes ease of cleaning.

DON'T sacrifice quality on built-in permanent heating equipment. To get the finest in modern, long-life heating . . . at lower over-all costs—follow the lead of top architects and heating engineers. Choose Modine Convector Radiation. It's your assurance of many years of heating system satisfaction. For complete information, see the Modine representative listed in your classified phone book. Or for your copy of Bulletin 251, write Modine Mfg. Co., 1511 DeKoven Avenue, Racine, Wisconsin.

Choose from three enclosure types in standard and heavy-duty institutional models for free-standing, recessed or wall-hung installation.



R-1173

FOR RADIANT HEATING *choose easy-to-bend* CHASE® COPPER TUBE

Fewer joints are needed when you use long lengths of easy-to-bend Chase Copper Tube. It's lightweight and comes in all sizes. Together with Chase Solder-Joint fittings it makes perfect radiant heating installations for walls, floors and ceilings. And you just can't beat Chase Copper Tube for quality, thermal conductivity and corrosion resistance. Write today for FREE 50-page book on Radiant Panel Heating.

Chase® BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper

Albany †	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
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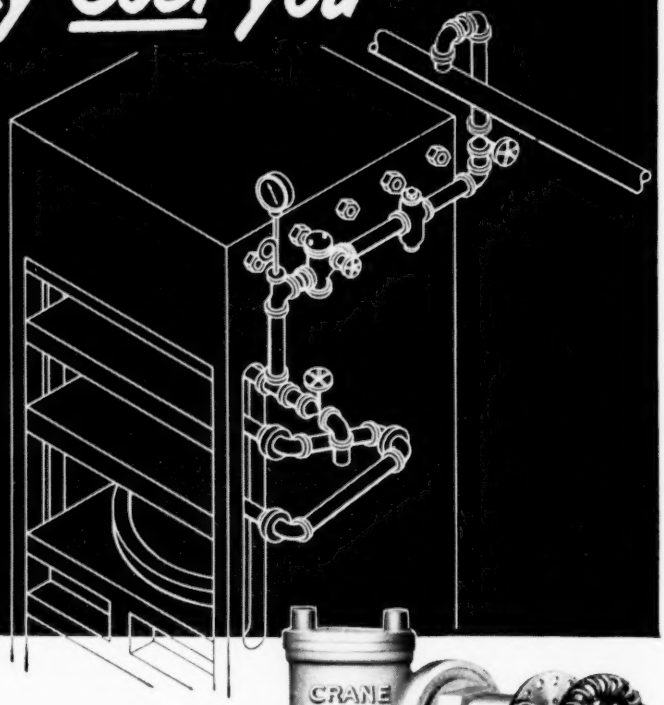
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston †	Newark	Rochester †	(† sales
Cincinnati	Indianapolis	New Orleans	St. Louis	office only)

It's not what you Pay for Valves . . . it's what they Cost you

on Steam Heated Machinery

for example

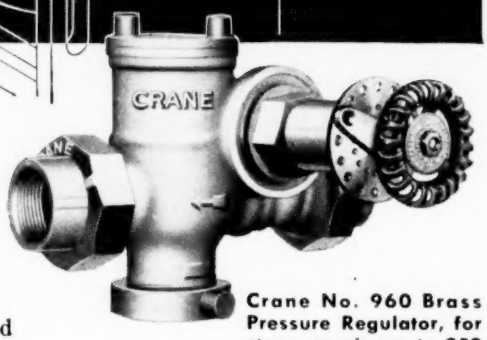
(A Case History)



What you pay for valves is not the final criterion of value. Not when maintenance can quickly equal or exceed purchase price. A thrifty buyer knows his maintenance; knows also there's bigger value in better quality.

Take the case at Dryden Rubber Division of Sheller Mfg. Corp., Chicago. More than 25 years ago, this plant started using Crane Pressure Regulators on steam lines to molding presses. 225 are in service today; many still are the original installations, still working faithfully. The records for all Crane regulators, regardless of age, show no maintenance cost other than prescribed periodic routine servicing.

Today, more than ever, you need greater assurance of quality in piping materials. You get it in Crane Valves—the recognized standard of quality with thrifty buyers everywhere. Your big Crane Catalog offers complete selections for all needs. Your Crane Representative is always ready to serve you.



Crane No. 960 Brass Pressure Regulator, for steam or air, up to 250 psi. See your Crane Catalog.

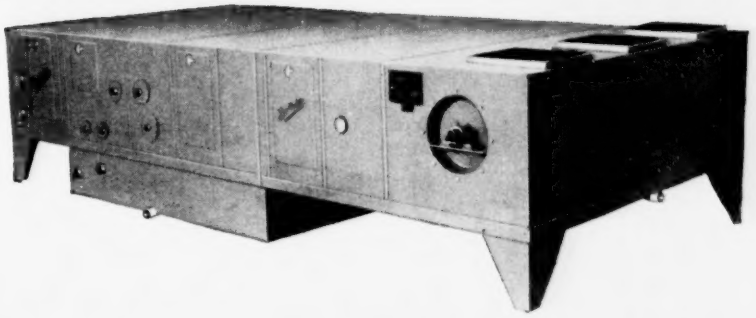
CRANE VALVES

Crane Co., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas.

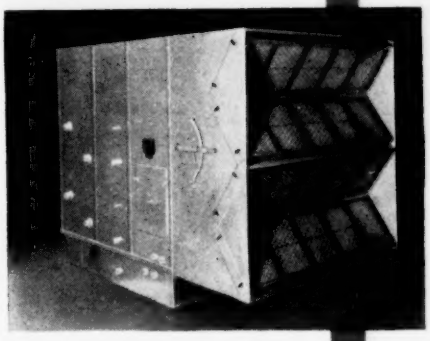
VALVES • FITTINGS • PIPE • PLUMBING • HEATING

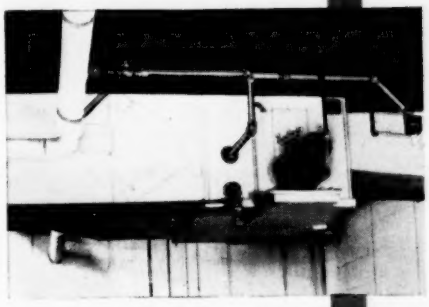
easy to install

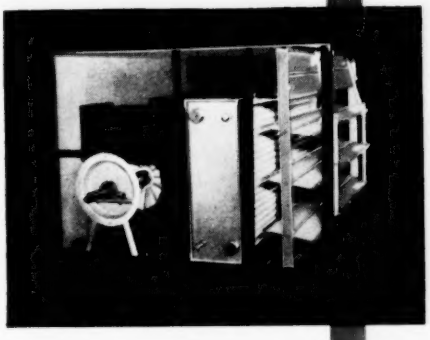
easy to live with "Buffalo"



"PC" CONDITIONING CABINETS







When you air condition, you want three things—as inexpensive a job as will do, equipment that installs economically—and most important—equipment that gives satisfaction over a long period.

Cost-wise, the central cabinet is the least expensive part of your system; considering compressor, duct-work and building modifications.

Satisfaction-wise, it's the most important!

If the fans are over rated, or inefficient, you'll suffer. If the coils are inefficient or untrustworthy, you'll have poor conditioning.

Why not be sure that on this lowest-cost part of your system, you get the best?

"Buffalo" "PC" Air Conditioning Cabinets, to heat, cool, humidify or dehumidify, or any combination of these functions, have been in use for more than twenty years. They are sectionalized, to pass thru standard building openings, and assemble easily on location. They have husky, quiet, mixed flow fans mounted on large, vibrationless hollow shafts. They have Aerofin coils, by far the best obtainable. They have sturdy, outside-the-housing bearings, for convenient lubrication even after cabinet insulation. In short they are built according to the "Q" Factor* which makes them your best buy!

"Buffalo" Engineering Sales Representatives in principal cities are anxious to serve you. Let them give you full details—no obligation.

*—*The "Q" Factor—the built-in Quality which provides trouble-free satisfaction and long life.*

DIAMOND JUBILEE 75TH ANNIVERSARY

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

480 BROADWAY BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

VENTILATING FORCED DRAFT | AIR CLEANING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT PRESSURE BLOWING | EXHAUSTING

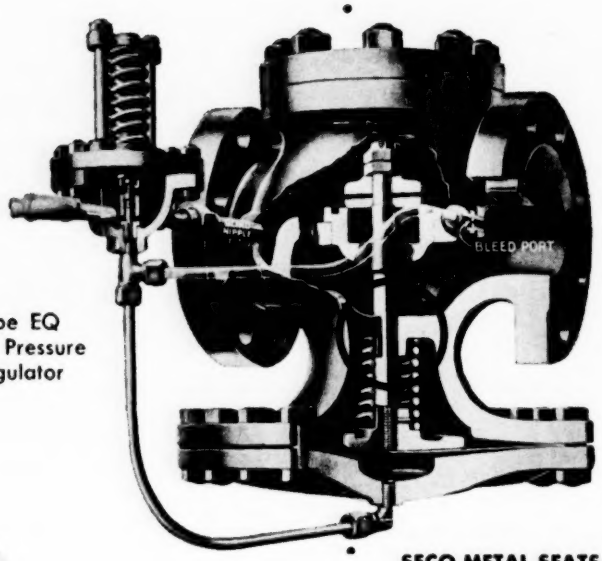
HOW SPENCE DESIGN...

eliminates stuffing boxes

All Spence main valves and most pilots are built without stuffing boxes. This packless construction is made possible by the use of a large balanced metal diaphragm which eliminates the need for closely fitted parts. Result? More accurate regulation.

Valve stem wear is also reduced in the Spence packless design. Result? Low maintenance, years of trouble-free service.

Spence makes a wide line of automatic regulating valves: Pressure, Temperature, Differential Pressure, Back Pressure, Pump Governors and many other types. Write for bulletin 100 giving full details.



Type EQ
Back Pressure
Regulator

A few other design features:

SECO METAL SEATS AND DISCS— Durable SECO Metal resists wiredrawing. More than twenty years of experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PROTECTED SPRINGS — The internal springs in the Spence Main Valve and Pilot are out of the path of the steam or other fluid flowing through the valve. They operate at low unit stress for exceptionally long life.

METAL DIAPHRAGMS — Located in a cooled zone with a condensate seal above and below, never have to be replaced under normal conditions.

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

SE121

"You can figure SURE savings"

Just make Dorex Air Recovery part of your air conditioning or ventilating installations. You'll please your clients with results like these —

In a New York skyscraper, Dorex Air Recovery eliminated the need for two large ducts up through 39 floors—saving expensive space as well as critical metal.

In a Pittsburgh building, Dorex Air Recovery cut the required air conditioning intake in half, saving some $17,000 on original equipment.

In Chicago, a large industrial plant installed Dorex and so reduced required boiler capacity that estimated fuel savings run about 2,500 tons of coal a year.

During the past twenty years, more than 10,000 Dorex installations have been made. Mail the coupon today for full information. Connor Engineering Corporation, Danbury, Connecticut.

CONNOR ENGINEERING CORPORATION

dorex®

air recovery

CONNOR ENGINEERING CORP.
Dept. B-33, Danbury, Connecticut

Please send me, without obligation, full information on Dorex Air Recovery.

Name.....

Position.....

Company.....

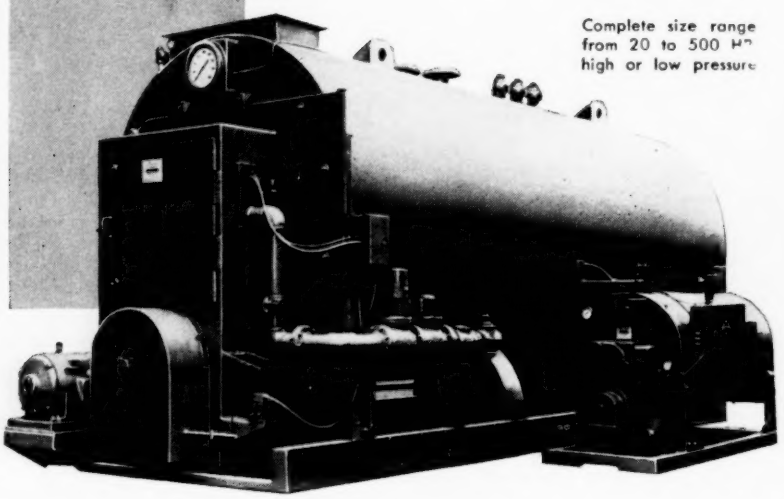
Street.....

City.....Zone.....State.....

CHAMPIONS IN BOTH FIELDS

3 you save three ways on steam with Continental AUTOMATIC BOILERS

. . . installation, fuel and maintenance!



Complete size range from 20 to 500 HP high or low pressure

Many of you saw the CONTINENTAL at the Heating and Ventilating Show . . . but do *you* know about these OUTSTANDING FEATURES:

ADVANCED TWO PASS DESIGN . . . eliminates baffles that may break or crack during operation, causing gases to by-pass and destroying the efficiency of the unit. Baffles that crack or break from wear must be replaced. *With the Continental,* 80% efficiency is *guaranteed.*

ACCESSIBILITY—*Continental* is the *only* boiler that can be opened at both ends for inspection and cleaning. Operation requires 30 minutes. Doors hinged on both ends make this a one man job.

FORCED DRAFT—A fan picks up clean cool air and forces it through the boiler. Since the air is clean, there is no danger of the fan picking up fly ash or soot: this naturally prolongs the life of the bearings and vanes.

MAXIMUM HEAT TRANSFER—Fuel is not burned in a refractory-lined furnace but is fired directly into the firing tube which is completely surrounded by water. This assures maximum heat transfer, complete combustion, a high CO_2 and a low stack temperature.

LONG SERVICE LIFE—The elimination of baffles and forced draft provides uniform distribution of heat through all tubes. This, in turn, insures long life because all tubes do equal work.

DRY STEAM—A separator—specially designed—insures steam 99% *dry.*

BURNERS—OIL AND GAS—*You save on fuel with Continental's exclusive firing method* (U. S. and foreign patents pending). *The oil burner* uses a pressure atomizing type nozzle. It is easy to service—there are no cups or moving parts to wear out. *The gas burner*—rather than pre-mixing—mixes the fuel and air at the point of ignition, thus producing a uniform, highly radiant flame.

FIVE SQUARE FEET PER HORSEPOWER—This assures you of power over 100% for emergencies—it's good insurance.

EASE OF INSTALLATION—Continental Boilers are shipped ready to operate. They are assembled and adjusted to maximum efficiency under actual firing conditions in our shop. No special stack, foundations or connections required. Continental is low in *initial* and *continued* cost.

Hundreds of boilers of this highly efficient, rugged design are setting records in economical, trouble-free service throughout the U. S. and Canada.

Find out how Continental can save you money on steam. Call or write us today for Catalog 102.

CONTINENTAL is sold, installed and serviced by competent distributors throughout the U.S.

BOILER ENGINEERING AND SUPPLY COMPANY, INC.
1 Manavon Street • Phoenixville, Pa.
40 Years of Boiler Manufacturing

The fittings that revolutionized pipe welding . . .

In the year 1931 Taylor Forge gave industry its *first real line* of seamless, butt-welding pipe fittings. We say it was the first *real* line because it was the first to include not only long and short radius ells, but also full branch and reducing tees, concentric and eccentric reducers, stub ends, caps and welding neck flanges.

This was a fully planned development. Many years before Taylor Forge had foreseen the future of the butt-welding fitting . . . had realized that pipe welding could not go beyond its then crude stage until pipe users were given *all* the fittings necessary to make up complete piping systems.

So Taylor Forge went to work on this and after long research and development came out with the full line that became the inspiration of modern pipe welding.

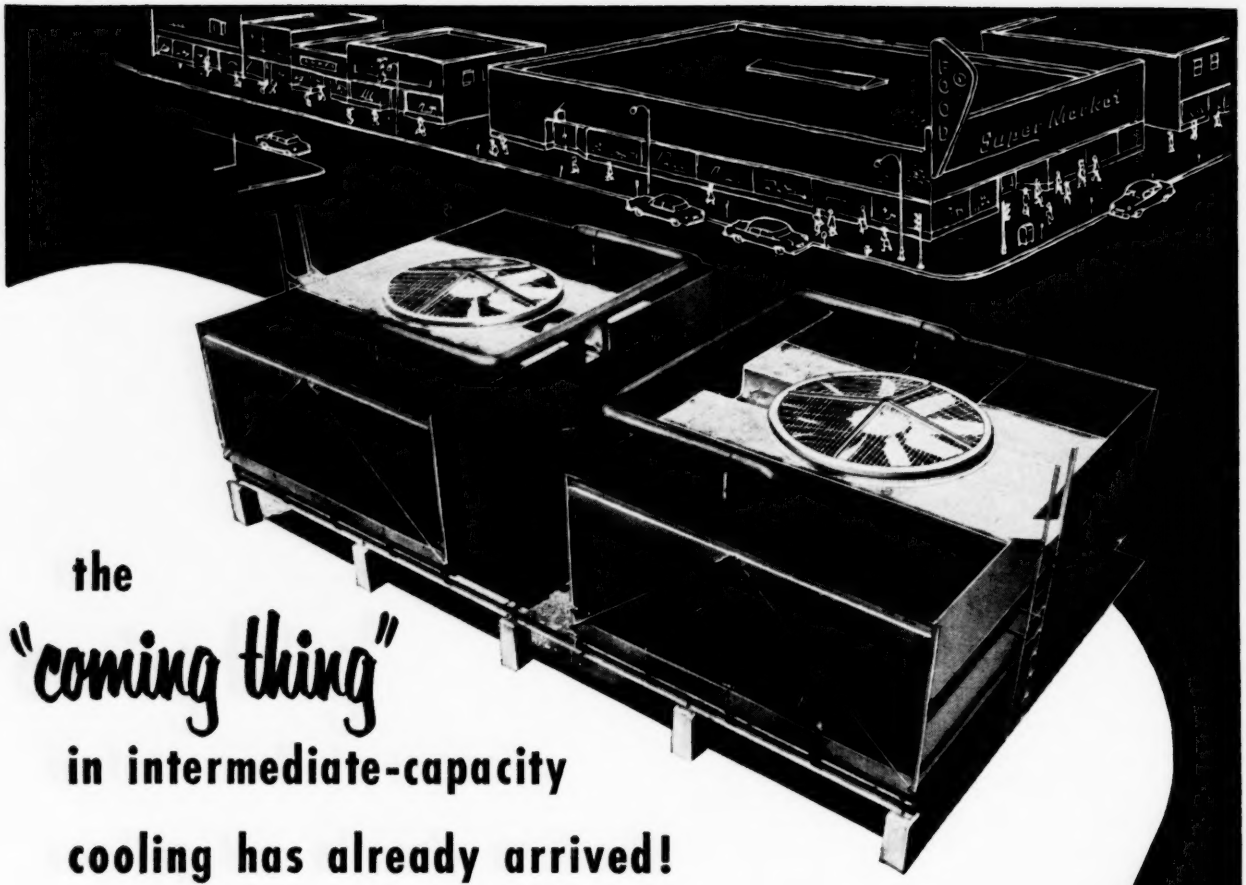
Naturally the organization that started ahead has kept ahead . . . in design, in quality, in breadth of line. That is why so many men who have followed the development of the WeldELL line, refuse to consider any other kind of welding fittings.

TF

For up-to-the-minute facts,
see your Taylor Forge distributor

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS, General Offices and Works: P.O. Box 485, Chicago 90, Ill.
Offices in all principal cities. Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada



the

"coming thing"

in intermediate-capacity

cooling has already arrived!

Marley Double-Flow Aquatower

Just one year ago, Marley introduced the Double-Flow Aquatower, a totally new concept in intermediate-capacity water cooling, to the air conditioning and refrigeration industry.

Trade acceptance was immediate. Engineers and contractors quickly recognized that the new towers offered every advantage of Marley patented Cross-Flow cooling, while retaining the operational simplicity of Marley's smaller Aquatowers. Everyone — architect, engineer, contractor, and customer — heartily approved the new design that reduced usual tower height up to 66%.

Today Double-Flow Aquatowers are in service throughout industry and commerce — on supermarkets, bus terminals, manufacturing plants and many other installations that require 50 or more tons of refrigeration. Readily available in a complete range of sizes, in all steel or wood with asbestos cement board casing, the Double-Flow Aquatower is the modern answer to your intermediate-capacity cooling problems.

producers of
DOUBLE FLOW TOWERS
AQUATOWERS
NATURAL DRAFT TOWERS
CONVENTIONAL TOWERS

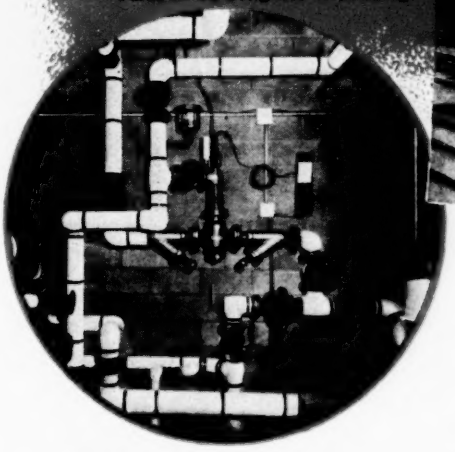
MARLEY

The Marley Company

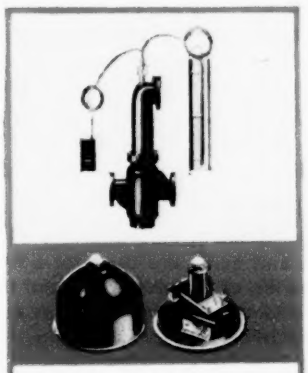
Kansas City, Missouri

Sarcotherm Heat Control System chosen for POTDEVIN MACHINE COMPANY'S LARGE PLANT at Teterboro, N. J.

86,000 ft. of steel pipe are arranged in serpentine coils for the radiant heating system. Heating Contractor, Frank Lawton, Paterson, N. J



One of the 5 Sarcotherm Control valves, protected by strainers. A Sarcotherm Air Eliminator will be noted at the right.



The heart of the Sarcotherm control system is this unique control valve. It is actuated by liquid expansion thermostats, one located outside the building and one in the valve itself. Between them they anticipate changes in heat loss ratio, thus maintaining comfort temperatures under all conditions.

The Sarcotherm Comfort Control "Thermoray" is an extremely sensitive thermostat affected by both radiation and convection.

This latest addition to the industrial plants at Teterboro terminal covers an area of 102 thousand square feet.

The single story building is radiant heated by floor coils requiring 86,000 feet of pipe.

The system is divided into five zones, each controlled by a 3″ Sarcotherm Control Valve, type STA-1D, with Thermoray heat-loss thermostat for each zone.

Sarcotherm also furnished Sarcoflow balancing fittings, access boxes, strainers and other accessories.

This is the largest single story industrial building in the East, radiant heated by floor coils.

We are proud that

Sarcotherm Control

was selected for this outstanding job. Individually engineered Sarcotherm Control systems are available also for conventional forced Hot Water or Steam Heating Systems. Our Engineering Department will be glad to assist on your next job.

24

Sarcotherm CONTROLS, INC.

EMPIRE STATE BUILDING · NEW YORK 1, N. Y.

A SARCO PRODUCT

ILLINOIS
Float & Thermostatic TRAPS

Assure lower return line temperatures

They're different!

–in construction

–in performance

ILLINOIS Float & Thermostatic Traps operate under vacuum with the same high efficiency as under pressure. No more water-logging of mains . . . no more air binding . . . end "morning overload" troubles. The instantaneous action of the condensate valve assures complete drainage of condensate. A separate thermostatically controlled valve vents air continuously in large volume, yet positively prevents loss of steam.

Recommended Applications

Low Pressure Heating Systems, Ventilating Units, Unit Heaters, Pre-Heaters, Re-Heaters, and other Fan System Heat Surface, Large Radiators or Pipe Coils, Hot Water Generators, Drips of Mains and Risers. Draining Coffee Urns, Warming Tables, Pasteurizers, Vacuum Pans, Heat Exchangers, Process Heaters, Sterilizers, Autoclaves, Cooking Kettles, Kilns and similar equipment.

(For operating ranges from 25 inches vacuum to 15 pounds pressure use Series G Traps. For pressures up to 50 pounds use Series MG.)

Rated capacities of various size traps from 200 pounds to 5000 pounds condensate per hour, at 2 pounds differential across the trap.

Positive, Instantaneous Valve Action . . . an Exclusive Feature

The Snap Action of the Condensate Control Valve assures efficient trap operation. The valve is not directly attached to float but is actuated by impact of the dropping float. Valve action is instantaneous whether the trap is handling its maximum capacity or only a trickle of condensate and regardless of variation in pressures. The valve is either wide open or tight shut—never cracked on seat, never hanging in an intermediate position. It is water-sealed at all times. It cannot chatter and is never affected by pulsations in the flow of condensate to the trap.

Simple, Compact, Trouble-proof

No ball floats to puncture or collapse—no toggles, pins, levers or hinges to corrode, stick or bend. Hard, stainless alloy steel renewable valves and seats are used for both condensate and air bypass units. Both valve units are at the top of trap out of dirt and sludge, assuring long life and satisfactory operation without attention. Straight through connections save head room, fittings, trenching, labor, and avoid low hung piping or lifts. Trap is easily opened for inspection without disturbing piping.

TRAP NOT DAMAGED BY FREEZING. Freezing will not harm this trap in any way and it is self-thawing.

Write for Bulletin 34-C

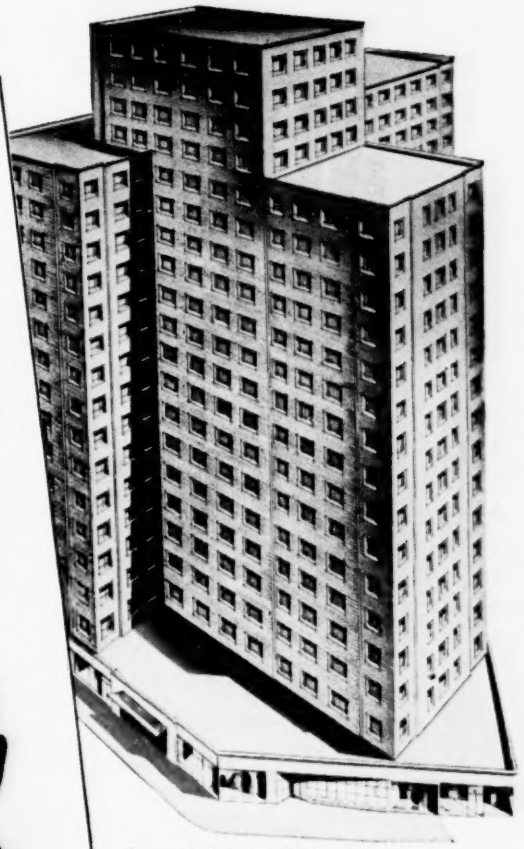
ILLINOIS ENGINEERING COMPANY
INCORPORATED 1900
RACINE AVENUE AT 21ST STREET • CHICAGO 8

ANOTHER REPORT OF READING COPPER TUBING "*ON THE JOB*" . . .

10 MILES of READING COPPER TUBING

in Pittsburgh's Newest Hotel!

"Did Better Job . . . Used Fewer Fittings . . . Saved Time and Labor Costs" . . Says Contractor



Benjamin Lessner, President, Benjamin Lessner Co., Inc., Philadelphia, Pa., Plumbing, Heating and Air Conditioning Contractor on the Carlton House, Pittsburgh, Pa.

The Carlton House, Pittsburgh's palatial new 600-suite hotel, is one of 16 multi-story hotel and apartment buildings, erected during the past several years, in which Benjamin Lessner Co., Inc. has installed Reading Copper Tubing. The Carlton House is completely air conditioned, using forced circulating water—heated for winter comfort and chilled for summer cooling. For this system and the building's hot and cold water lines, Lessner engineers estimate approximately 10 miles of Reading Copper Tubing were required. Reasons given by Benjamin Lessner for his company's preference for Reading Copper Tubing include uniform wall thickness, precision manufacture to close tolerances and ease of bending with ordinary tools and methods which greatly reduces the number of fittings. On one job, Lessner reports a saving of 4200 copper sweat ells. Where joints were necessary, Reading Copper Tubing was easy to fit with standard sweat fittings.

Reading Copper Tubing is available in soft and hard temper types in a wide range of sizes. It comes in handy straight lengths and coils—a tubing for every type of installation in hot and cold water lines, radiant panel heating, air conditioning, underground service and processing lines. Specify Reading Copper Tubing when you order from your plumbing and heating supply wholesaler.

READING TUBE CORPORATION

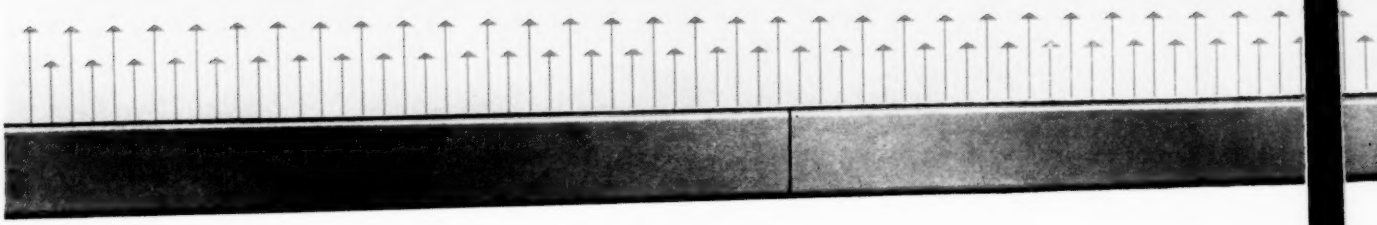
Producers of Reading Lektroneal Copper Tubing and Reading 85% Grade A Red Brass Pipe

OFFICES AND EASTERN DISTRIBUTION DEPOT:
36-12 47th Ave., Long Island City, N. Y. • STillwell 6-9200
WORKS: READING, PA.

READING COPPER-BRASS TUBING

DISTRIBUTION DEPOTS: Reading, Pa. • Long Island City, N. Y. • Houston, Texas, 1121 Rothwell St. Chicago, Ill., 724 W. 50th St. • Atlanta, Ga., 690 Murphy Ave. S.W. Unit 5, Bldg. B

NEW! Trane Unit Ventilator 40-foot blanket of FORCED,



HEATS MORE EVENLY...ends cold corners

VENTILATES MORE UNIFORMLY...ends stale spots

STOPS DOWN-DRAFTS CONSTANTLY...ends window chill

No other unit ventilator ever built can blanket the entire outside wall with a forced upward flow of tempered air, providing better heat and air distribution and also protecting children from down-drafts, even when the heat is off!

Big news! A really basic engineering improvement in unit ventilator development . . . the new TRANE Unit Ventilator System! Architects, engineers, contractors, manufacturers and school boards have long agreed that the ideal unit ventilator would blanket large window areas with a *continuous*, forced stream of tempered air.

Now TRANE product engineers have actually built a unit that accomplishes the ideal . . . *constant* perimeter heating with individual unit control. Now you can have a classroom ventilator that will stop window draft with an upward moving blanket of tempered air. Do it *every minute the room is occupied.* Do it quietly.

Here's how it works: Part of the warmed air delivered by the new TRANE Unit Ventilator is forced out through two wings. This scientifically designed, easily installed ductwork distributes air uniformly along the entire wall. Special fans in the unit ventilator keep this air under pressure . . . forcing it *constantly* and *evenly*, even when the thermostat calls for no heat. Yes, it protects school children from drafts *even when the heat is shut off!*

The new TRANE Unit Ventilator blends room and outside air, tempers it with just the right amount of heat, and distributes it *evenly* throughout the room . . . eliminates cold corners and stale air spots for good!

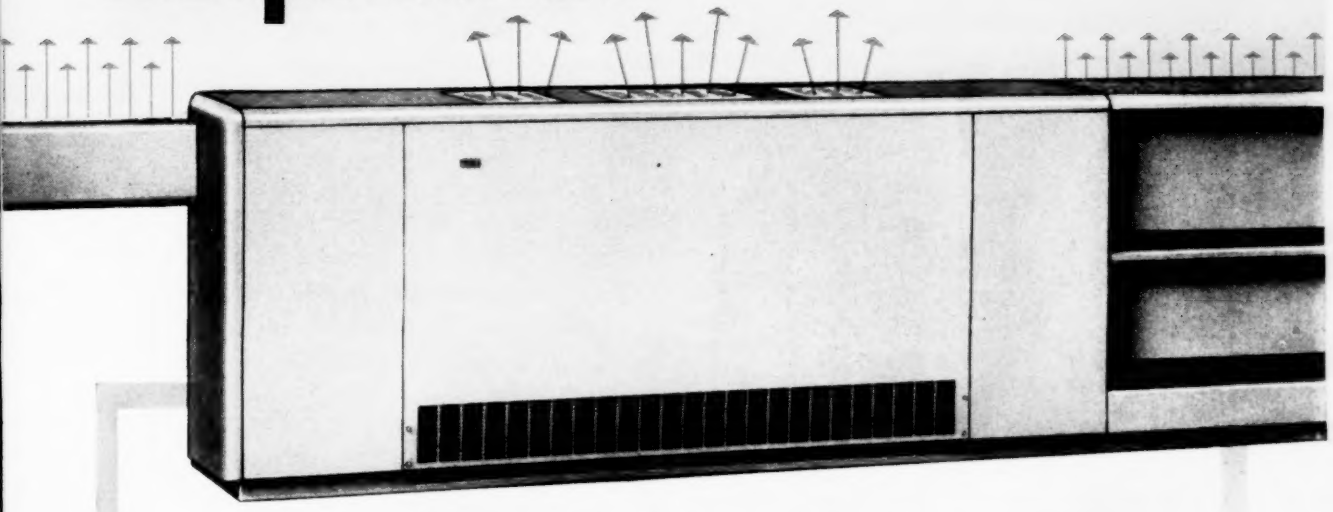
No other unit ventilator system can deliver such constant, even distribution of heat and ventilation air . . . plus complete protection against window drafts.

For more details, contact your TRANE sales office, or write TRANE, LaCrosse, Wis.

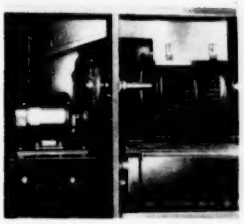
New TRANE

MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR

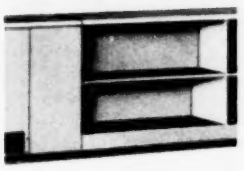
delivers continuous tempered air *[even when heat is off!]*



Laboratory photo of smoke test shows how this new idea works. Blanket of warm air moves upward from ducts in an even, solid stream. Drafts can't penetrate. Ducts come in 5-foot lengths, with a maximum extension to 15 feet from each side.



Exclusive fan, motor arrangement. Low velocity fans deliver air out through ducts, others move air through top of unit. Exclusive shaft and bearing assembly assures quiet operation. Standard motor, rubber mounted to stop noise.



Shelving optional—the new TRANE Unit Ventilator's ducts fit neatly into handsome, easy-to-install, bolt-together shelving. You can choose standard units in either open or closed shelving with a continuous, smooth top surface.

Removable panels—give easy access to all 3 sections. Front of each fan scroll detaches for easy cleaning. Filters are easy to replace or clean. Controls can be adjusted with panel in place, with unit in operation . . . a TRANE exclusive.

A great addition to TRANE's complete line of school heating and ventilating equipment

Centrifugal Fans

Heating Coils

Wall-Fin

Convectors

Unit Heaters

Unit Ventilator System

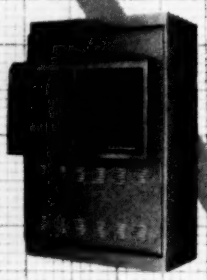
smothers every inch of draft . . . every minute of the day!

CONDITIONING EQUIPMENT The Trane Co., La Crosse, Wis. • East. Mfg. Div., Scranton, Pa. • Trane Co. of Canada, Ltd., Toronto • 80 U.S., 14 Canadian Offices

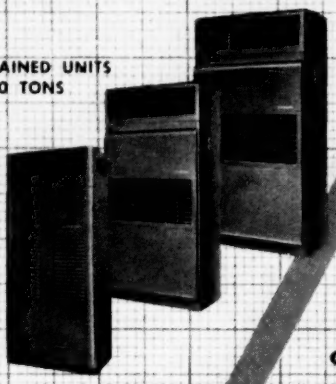
Quality-Engineered by

TYPHOON

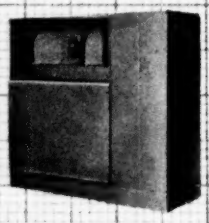
DEPENDABLE EQUIPMENT FOR YOUR AIR CONDITIONING NEEDS



SELF-CONTAINED REMOTE UNITS 15 AND 20 TONS



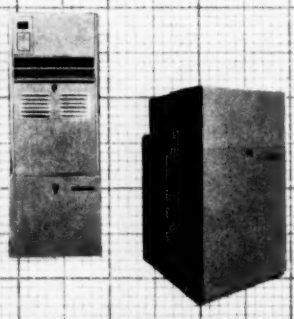
SELF-CONTAINED UNITS 1½ TO 10 TONS



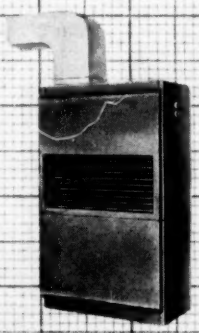
EVAPORATIVE CONDENSERS 3 TO 20 TONS

Whether the job calls for a single packaged air conditioning unit or a central plant . . . a residential year-round unit or a heat pump — you can count on Typhoon equipment to supply your needs. And Typhoon's quality engineering — backed by over 40 years of experience — is your guarantee of trouble-free performance.

Satisfied Typhoon users include famous companies like RCA, Grand Union Stores and Whelan Drug Stores. They've found Typhoon equipment tops in economical operation . . . tops in cooling efficiency. You will, too.



RESIDENTIAL SUMMER-WINTER UNITS 2, 3, 5 TONS



PROP-R-TEMP HEAT PUMPS 2 TO 20 TONS

Also . . .
Heating and Cooling Coils
Air Handling Units
Cooling Sections to Supplement Furnaces
Water Chillers
Multi-Package Systems
Steam or Water Boilers
Window Units ⅓, ½, ¾ and 1 HP

Write for Detailed Information

TYPHOON AIR CONDITIONING CO., INC.

794 Union Street, Brooklyn 15, N. Y.

Specialists in Air Conditioning Since 1909

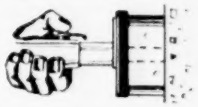
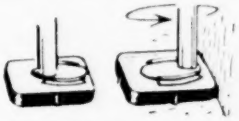
DRIVE-IT

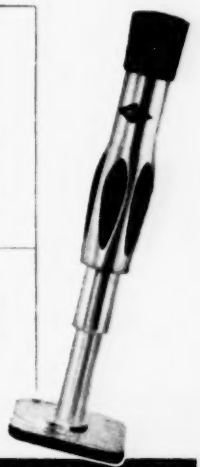
ANCHORS DUCTWORK TO STEEL BEAMS AND CONCRETE CEILINGS

DRIVE-IT "300" fastened this large ventilating system to the steel roof framework and concrete ceilings of the new Central Vocational School, Cincinnati, Ohio. DRIVE-IT powder operated fastening system was used as the fastest, easiest method of making concrete or steel anchorages. Headed pins were driven into steel beams anchoring the angle supports and threaded pins driven into concrete for ductwork and rod hangers. B. & J. Jacobs Company was the contractor.

split-second fastening to concrete steel

Drive-It uses a small powder load to drive hardened steel pins into concrete or steel. No power lines! No drilling!

UL ***DRIVE-IT,*** the *first* powder actuated tool approved by Underwriters' Laboratory.	 ***DRIVE-IT*** cannot be discharged accidentally due to the push and turn sequence. This, plus the large safety pad makes *DRIVE-IT* triple safe.	 Exclusive Automatic Barrel Extension for fastenings inside junction boxes or other recesses.
 DRIVE-IT is the only powder-actuated tool which requires but one standard power load regardless of penetration desired.	 Exclusive Swivel Safety Pad easily rotated for getting into close quarter work.	***DRIVE-IT*** "300", lowest cost fastening tool. Low original cost and low operating cost.



a drive-pin for every job

OVER 50 TYPES AND SIZES

MAIL THIS COUPON TODAY!

POWDER POWER TOOL CORP.

7526-A S. W. Macadam, Portland 1, Oregon

Canada: Ammo Power Tool Co., Ltd.
735 Broadway, Vancouver, B. C.

☐ Please send FREE catalogue and literature.
☐ I want a FREE demonstration of *DRIVE-IT.*

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Street _____

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Get balanced performance through matched equipment

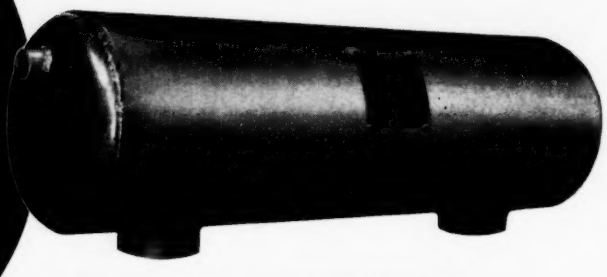
TEAM-UP Acme products for top efficiency

Acme DRY-EX WATER CHILLER

High efficiency is assured by Acme's method of making available multiple combinations of water side baffle spacings and refrigerant heads. There is a design to fit each application from 5 to 260 tons and for fluid circulation rates from 10 to 600 gallons per minute.

Acme OIL SEPARATORS

For positive oil separation from 1/4 to 100 H.P. you should specify the easy to install, economical to buy Acme oil separators. There is no gamble with the life of your compressor when you use an Acme oil separator.



Acme HEAT EXCHANGERS

Acme shell and tube type heat exchangers include 11 standard models with capacities from 3 to 200 tons. They feature low pressure drop and high performance. The extended bar type fin surface permits the maximum amount of surface being furnished in a minimum amount of space. System capacities have been greatly improved as result of liquid sub-cooling and the elimination of liquid slugging and flash gas.

Acme CONDENSERS

Acme has both shell and tube and shell and coil condensers available for use with either Freon or Ammonia refrigerants. There are well over a hundred standard sizes and capacities ranging from 1/2 to 700 tons. Each series of condensers within the Acme line was designed for a specific purpose. The exact model for your requirements is always available.

ACME PRODUCTS

ACME INDUSTRIES, INC.

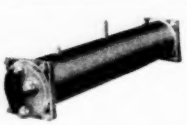
JACKSON, MICHIGAN

Mfgs. of a complete line of Air Conditioning and Refrigeration Equipment

Evaporative Condensers
Cooling Towers
Floor-type Unit Coolers

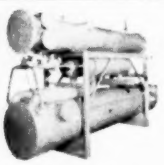
Direct Expansion (Dry-Ex) and Flooded Liquid Chillers

Heat Exchangers, Oil Separators



Shell and Tube, Shell and Coil Condensers

Receivers, Pipe Coils



Packaged Liquid Chillers to 225 tons

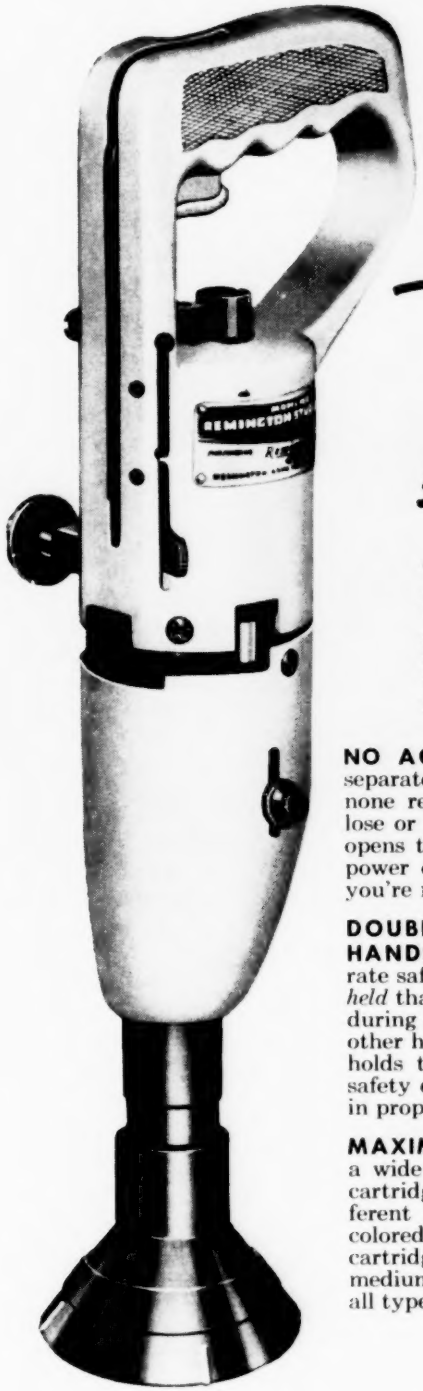
Flow-Temp Heat Pumps

Flow-Cold Liquid Chillers

Convectors for Heating and Cooling

Continuously serving the refrigeration and air conditioning industry since 1919

MODEL 450 REMINGTON STUD DRIVER



—the ONLY powder-actuated fastening tool with ALL these advantages—

The Model 450 Remington Stud Driver sets up to 5 fastening studs per minute—a speed unmatched by other powder-actuated tools. Completely self-powered, this amazing tool fastens steel or wood structural pieces to concrete or steel surfaces in seconds. Its light weight—only 5½ pounds—makes it ideal for use overhead or in confined spaces. Check these other exclusive Remington Stud Driver features:

NO ACCESSORIES REQUIRED. No separate parts needed to control power, none required for loading—nothing to lose or break. Just a twist of the wrist opens the Model 450. Insert stud and power cartridge as a unit . . . close and you're ready! Whole job takes seconds.

DOUBLE-SAFE—REQUIRES *BOTH* HANDS FOR OPERATION. A separate safety lever must be depressed and *held* that way with one hand before and during squeezing of the trigger with the other hand. Safe, two-handed operation holds the tool steady. Two *additional* safety devices prevent operation except in proper fastening position.

MAXIMUM POWER RANGE. You get a wide choice of power in Remington cartridges. They're available in six different loads, each clearly marked by colored plastic heel caps. The 32 caliber cartridge gives you extra power in this medium-duty tool . . . helps you speed all types of fastening jobs.

ARROW-STRAIGHT DRIVING—BETTER GAS SEAL. New, long plastic heel cap on all Remington cartridges provides perfect gas seal . . . gives the Model 450 more power. Assures controlled, consistently straight driving.

FAST, POSITIVE EJECTION. Exclusive ejector snaps fired case out of tool instantly—no fumbling, no tools needed.

Test-proved to be the world's finest and speediest fastening system, the Model 450 Remington Stud Driver is made by the Remington Arms Company, Inc., *America's oldest and foremost sporting arms manufacturer.*

NEW, FREE BOOKLET shows you a hundred different ways the Model 450 Remington Stud Driver can speed *your* construction fastening. Packed with illustrations, it tells you where and how this tool can save time, reduce fatigue and cut costs. Send in the coupon below for your copy.

Listed & Approved by Underwriters' Laboratories, Inc.

"If It's Remington—It's Right!"

Remington

DUPONT

MAIL THIS COUPON TODAY

Industrial Sales Division, Dept. HV-3
Remington Arms Company, Inc.
939 Barnum Ave., Bridgeport 2, Connecticut

Please send me my *free* copy of the new booklet showing how I can cut my fastening costs.

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Position _____

Firm _____

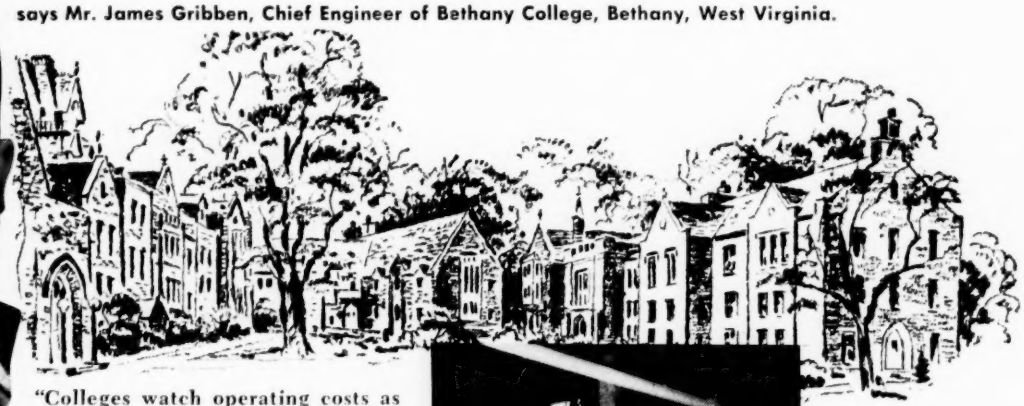
Address _____

City _____ *State* _____

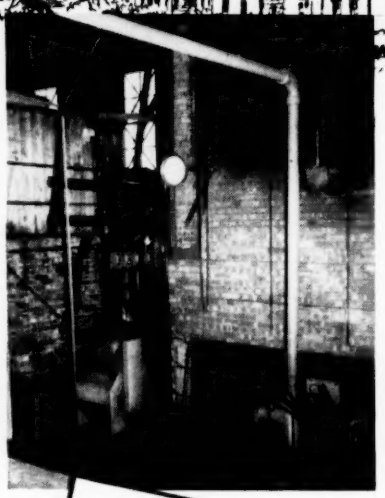
"We 'educated' our College Heating Plant...

with a modern coal installation we saved more than a third of our fuel bill,"

says Mr. James Gribben, Chief Engineer of Bethany College, Bethany, West Virginia.



"Colleges watch operating costs as closely as any business firm—and one big item for our college is the heating bill. That's exactly why Bethany went to the expense of putting in new coal heating equipment! Our old system supplied heat for sixteen buildings—to the tune of 2,600 tons of coal a year. Our new installation, with its automatic stoker, does the same job using only 1,650 tons. That's a fuel saving of 38.9%! Our eyes certainly have been opened to the efficiency and economy of *bituminous* coal—especially when it's burned with modern equipment."



Here's Bethany's new boiler room, showing the pipe of the automatic stoker. **THIS MODERN EQUIPMENT WILL PAY FOR ITSELF, THROUGH FUEL SAVINGS ALONE, IN LESS THAN TWO YEARS!**

Modern combustion installations can add anywhere from 10% to 40% to the energy obtained from the same amount of coal in years gone by. Great advances have been made in coal- and ash-handling equipment, too—cutting labor costs—making coal as clean and convenient to use as any fuel.

If you're planning to modernize your present installation—or thinking of building a new plant, call in a competent consulting engineer. He'll show you how a modern coal system designed to meet your specific needs can save you money and serve you better!

And don't forget—you'll always be able to get the coal you need. America's coal industry is the most efficient in the world. America's coal reserves are ample for centuries to come. Right now and for the future, too, coal users can be assured of a dependable fuel supply at reasonable prices.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
Washington, D. C.

If you're running your own steam plant—for heat or for power—you just can't afford to ignore these facts!

COAL in most places is today's most economical fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

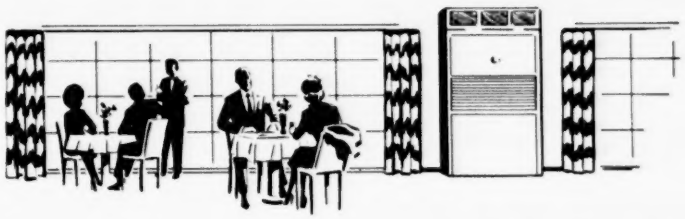
COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY FOR LOW COST

YOU CAN COUNT ON COAL!



HERE'S WHY THE PIONEER "PACKAGED" AIR CONDITIONER LEADS ALL THE REST

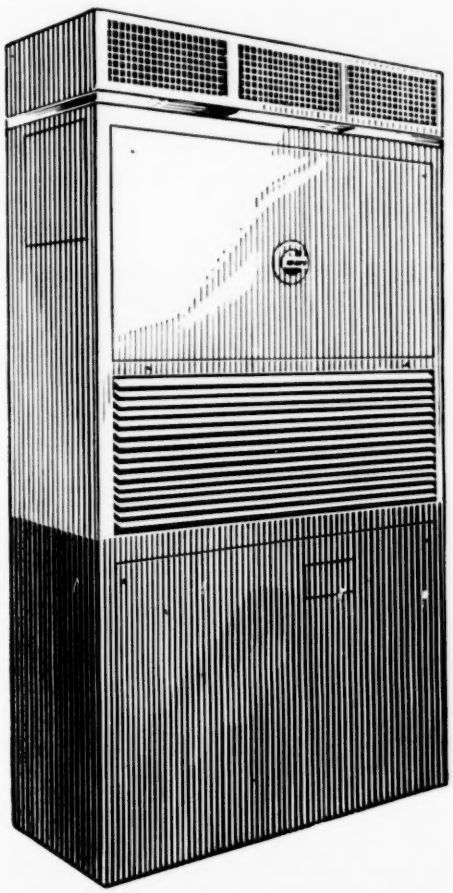
The first mass-produced "Packaged" Air Conditioner in the United States was shipped in March, 1937, by Chrysler Airtemp.

Today, 16 years later, they are still the leader among many, many brands of Air Conditioners. There are several reasons why Chrysler Airtemp dealers sell more "Packaged" Air Conditioners.

- Chrysler Airtemp pioneered and perfected the high-speed radial compressor design. The dependability of this advanced unit is time-proven. Thousands of these compressors sold in 1937 are *still* in use!
- Chrysler Airtemp first offered the optional 5-year warranty for you, and your customers' protection.
- Precision manufacturing and assembly in an air conditioned factory assure long life—low maintenance—high efficiency.
- Best proof of all—no major design change has been necessary since 1937. Chrysler Airtemp sells more "packaged" air conditioners because they're the best!

It will pay *you* to sell Chrysler Airtemp "Packaged" Air Conditioning—get all the facts. Mail the coupon today.

Comfort Zone FOR PROFIT



"Packaged" Air Conditioners
Six models from 2 to 15 H.P. capacity. Meets every cooling need.

Guaranteed by Good Housekeeping

Chrysler Airtemp

HEATING • AIR CONDITIONING
***for* HOMES, BUSINESS, INDUSTRY**
Airtemp Division, Chrysler Corporation, Dayton 1, Ohio

Airtemp Division, Chrysler Corporation H&V-3-53
P.O. Box 1037, Dayton 1, Ohio

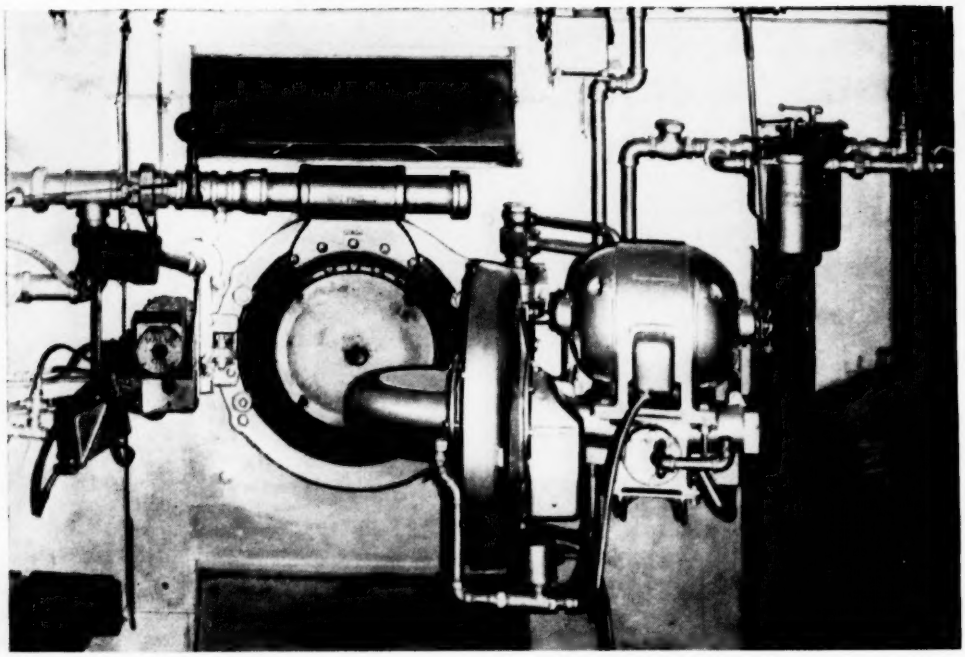
Please send full details on the Chrysler Airtemp Comfort Zone "Packaged" Air Conditioning proposition.

Name_____

Address_____ Phone_____

City_____ Zone____ State_____

Change fuels at a moment's notice



MR. JOHN H. MILLER, *General Manager*, New Method Laundry, Columbus, Ohio.

"Iron Fireman gas-oil firing is profitable investment"

"Four years ago we installed Iron Fireman gas-oil firing in our 200 horsepower water tube boiler. During peak periods our load often exceeds 150% of rating. Heavy steam demands are required without warning. Iron Fireman gas-oil firing has met the test. The changeover from gas to oil and back again can be made in a few minutes, without interruption. Our steam costs are low, and maintenance is negligible."

At left, Iron Fireman Ring Type gas burner in operation in the New Method Laundry boiler room. Iron Fireman Rotary heavy oil burner is swung back out of firing position.

Iron Fireman

Dual or Triple Fuel Firing

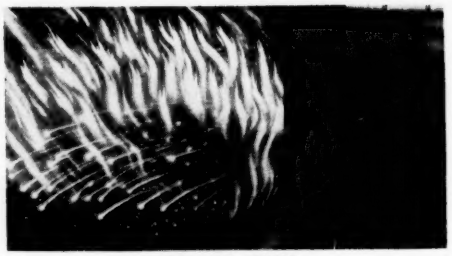
Use GAS, OIL and COAL interchangeably

With Iron Fireman firing you can burn any fuel you wish interchangeably—gas-oil, gas-coal, oil-coal, or all three. In woodworking plants any or all of these fuels are successfully combined with a fourth—wood waste.

High combustion efficiencies are obtainable with oil, gas or coal. As price advantage shifts from one fuel to another your steam plant can shift with it—for the long pull if necessary. Or you can change fuels every day when desirable. This is routine practice in plants where the gas supply is reduced during daily peak periods.

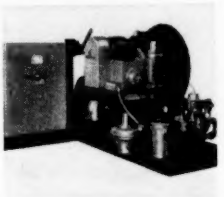
Avoid costly shut-downs

Fuel emergencies, due to interrupted or short supply, can be disastrous. Yet protection against such emergencies may cost you little or nothing when offset by the fuel and labor savings of Iron Fireman multiple fuel firing.



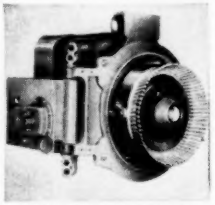
GAS, OIL, COAL

Equipment includes Ring Type gas burner, Rotary oil burner, and Pneumatic Spreader stoker. Coal is automatically dried, pre-heated and conveyed from bunker to boiler. No manual handling; no costly conveying equipment.



GAS-OIL PACKAGE UNIT

For Scotch marine and other types of boilers. Has integral forced draft and control panel wired and tested at factory.



GAS-OIL BURNER

Ring Type Gas Burner and Rotary Oil Burner on single mounting. Fuels can be shifted instantly.

Send for full information

IRON FIREMAN MANUFACTURING CO.
3071 W. 106th Street, Cleveland 11, Ohio.
Please send literature on Iron Fireman multiple fuel firing.

Name .....
Address .....
City ..... State.....

AUTOMATIC FIRING FOR HOMES, BUILDINGS, INDUSTRIAL PLANTS

The Master Reference Book of the Industry

The Edition You've Been Waiting For . . . . . The New Revised 1953 Edition of the

HEATING VENTILATING AIR CONDITIONING GUIDE

Ready in March

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There is Nothing Comparable to the NEW 1953 Edition of the HEATING VENTILATING AIR CONDITIONING GUIDE

Use it to help solve your engineering problems—keep it handy for ready reference. Engineers—Contractors—Dealers—Architects—Students—use this book constantly to help solve heating, ventilating and air conditioning problems. All chapters of the new 1953 Edition have been edited, revised and brought up-to-date. Nowhere else can be found such a wealth of practical, useful data as is contained in this big 1560 page book. Here you will find 51 chapters—51 good reasons why you owe it to yourself to own a copy of THE GUIDE.

THE GUIDE is unique—different—there is nothing like it! It is an indispensable tool—a ready reference volume for use when estimating and planning construction work. It is a "must" for engineers who need the technical data for design and calculation and writing specifications. Architects need it for coordinating heating, ventilating, and air conditioning design with their plans and specifications. Superintendents, factory engineers, operators, and managers of large structures, office buildings, schools, auditoriums, and institutions, all use THE GUIDE for help in their everyday problems.

TYPICAL SECTIONS

AIR CONDITIONING SYSTEMS: Equipment arrangement, and operation for year 'round air conditioning explained simply. Cost of owning and operating outlined. **AIR CONTAMINANTS:** Nature and control of contaminants in air discussed, and limits indicated. **AIR DISTRIBUTION:** Standards and methods for proper air distribution given. Formulas and charts included to aid in selection of outlets. **AIR DUCT DESIGN:** Includes ASHVE Air Friction Charts, together with basic formulas and tables for rectangular equivalents of round ducts and friction loss in elbows. Practical design for duct system illustrated. **CHIMNEYS:** Theory and actual operation of large and small chimneys considered. Formulas and charts for selecting residential chimney sizes included. **CODES:** Latest editions and sources of 145 codes and standards compiled for ready reference. **COOLING LOAD:** Weather design data for 316 localities listed. Solar heat gain tables included for glass, glass block, and figured rolled glass from ASHVE research. Simplified method shown for computing heat gain through walls and roofs. **DRYING SYSTEMS:** Theory and methods of drying outlined. Typical drying equipment illustrated. **FLUID FLOW:** Basic theory of fluid flow through pipes, nozzles, and orifices presented clearly and concisely. **FUELS, COMBUSTION, AND EQUIPMENT:** Gives properties of present-day fuels and their combustion data. Adjustment and operation of fuel-burning equipment explained. **HEAT LOSS CALCULATIONS:** Includes basic formulas and extensive tables for determining building heat loss for typical construction. Weather design conditions given for U. S. and Canadian cities. **HEAT TRANSFER:** Basic formulas applying to heat transfer by conduction, convection, and radiation are developed. Unit conductances for thermal convection for various surfaces are tabulated. Net radiation solutions for various relative positions of surfaces are given. **HEATING SYSTEMS:** Various types of steam, hot water, panel, warm air, and all-year comfort systems described. Data for determination of pipe and duct sizes. **INDUSTRIAL AIR CONDITIONING:** Design conditions given for manufacturing large number of products. **INDUSTRIAL EXHAUST SYSTEMS:** Data given for design of hoods, ducts and complete systems. **INSTRUMENTS:** Outlines methods of measurement and instruments used in heating, ventilating and air conditioning. **PANEL HEATING:** A simple method for design of panel heating systems, including snow melting. **PHYSIOLOGICAL REACTIONS:** Basic data and standards for comfort, explains reaction of human beings to atmospheric environment outside comfort range. Includes ASHVE Comfort Chart. Shows value of air conditioning in prevention and treatment of disease. **REFRIGERATION:** Simple presentation of different refrigeration cycles, types and functions of equipment, and controls. Outlines factors affecting use of the heat pump. **THERMODYNAMICS:** Simple discussion of thermodynamics in air conditioning, with illustrative problems showing use of ASHVE Psychrometric Chart and tables of properties of air from —160 F to +200 F. **WARM AIR SYSTEMS:** Design of gravity and forced circulation systems simplified by use of tables. Small duct, perimeter and ceiling panel systems described. **WATER SERVICES:** Shows how to determine service water demand, pipe sizes for cold and hot water systems, for cooling towers and for refrigeration. Gives data for selection of heater and storage tank capacity.

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THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, 62 Worth St., New York 13, N. Y.

Enclosed is $7.50 for standard edition of Heating Ventilating Air Conditioning Guide 1953, please send me a copy. It is understood that I may return it within 10 days, if it is not satisfactory, and you will refund my money.

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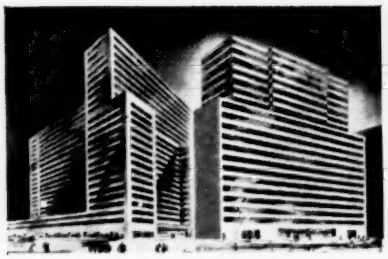
HV

HOW York's Advanced Systems take the compromise out of air conditioning

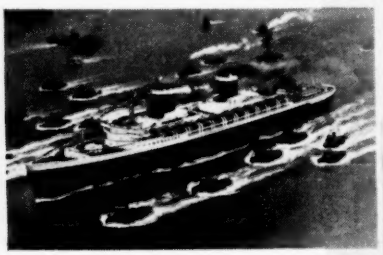


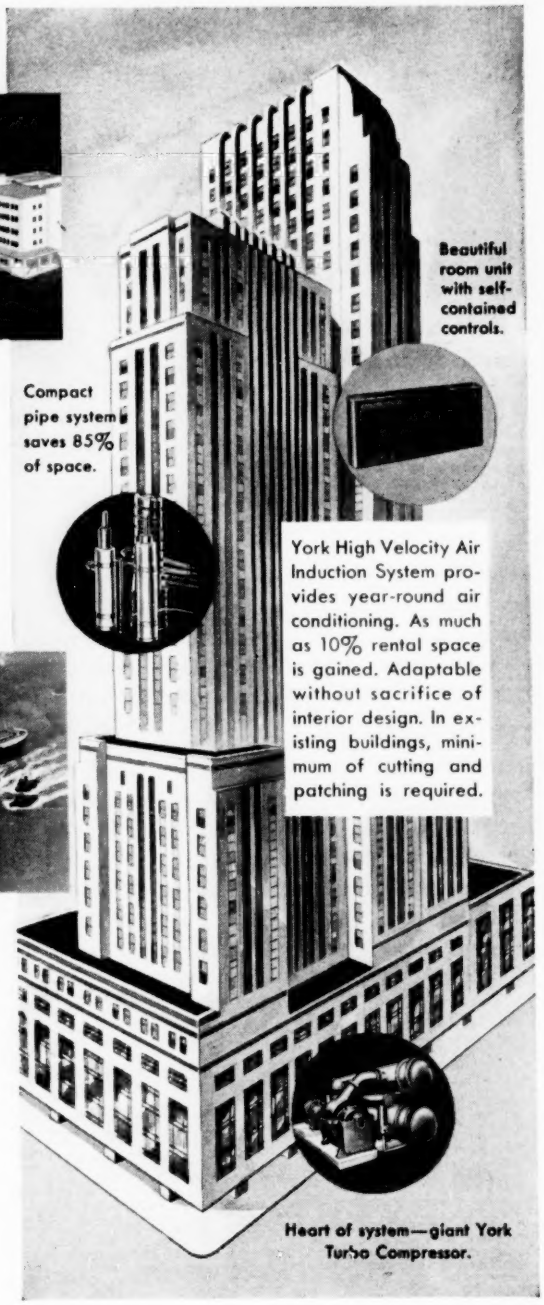
York Unitary System in world's first fully air conditioned skyscraper apartments—Philadelphia's Rittenhouse Claridge and Savoy. One central station with individual room controls.

York High Velocity Double Duct System was selected by the St. Francis Hospital in Lynnwood, Calif. to meet the exacting requirements of one of the world's most modern hospitals.

York Turbo Cooling Systems in Empire State Building shoot a column of ice water to cloud level to provide individual air conditioning for occupants. Tenants select room unit they prefer.

Battery of Giant York Turbo Compressors—heart of the air conditioning in the world's fastest luxury liner, the new S. S. United States. Equipment could air condition average suburb.




Beautiful room unit with self-contained controls.
Compact pipe system saves 85% of space.
York High Velocity Air Induction System provides year-round air conditioning. As much as 10% rental space is gained. Adaptable without sacrifice of interior design. In existing buildings, minimum of cutting and patching is required.
Heart of system—giant York Turbo Compressor.

Making a system fit a building or radically changing a building to fit a system . . . that's neither good engineering nor is it good business.

With the industry's *widest* range of equipment at their command, York engineers sit on *your* side of the desk. They are not obliged to sell—or try to adapt—a fixed system to your special requirements.

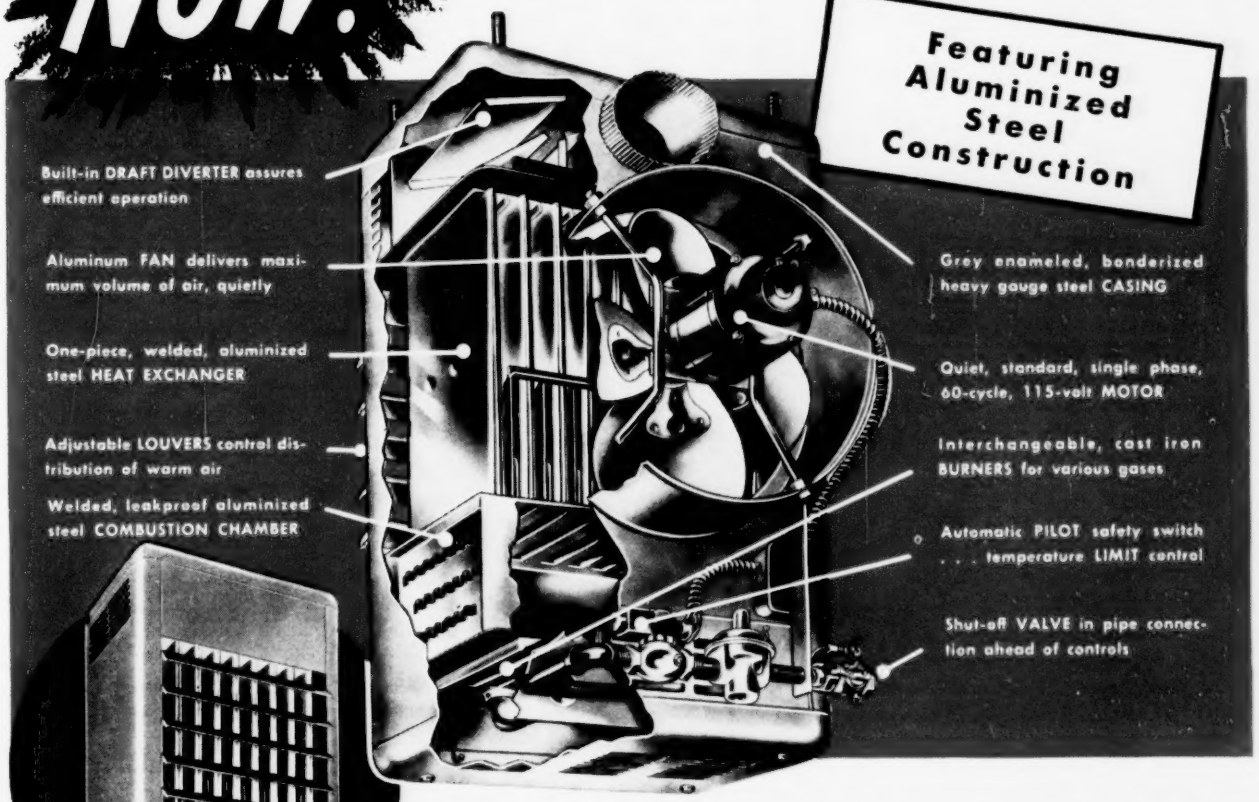
Backed by ever-expanding factory research and development that has followed one profession for 68 years—*mechanical cooling*—York Engineers can recommend the precise system to give you better performance, longer life at low initial and operating costs.

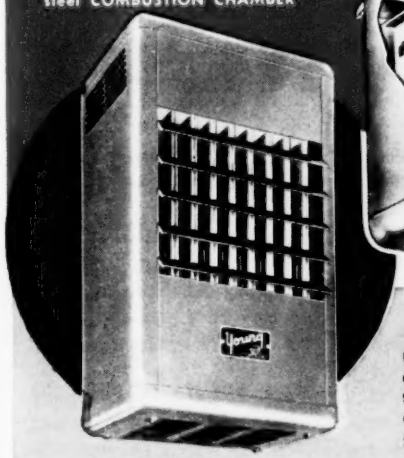
A consultation can result in vital savings in time, money and worry for you. You'll find the nearest York Engineering Office listed in your Classified Telephone Directory. Or, if you prefer, write to York Corporation, York, Pennsylvania.

YORK AIR CONDITIONING AND REFRIGERATION
HEADQUARTERS FOR MECHANICAL COOLING SINCE 1885

NOW! YOUNG OFFERS YOU Gas-Fired Unit Heaters

Featuring Aluminized Steel Construction


Built-in DRAFT DIVERTER assures efficient operation
Aluminum FAN delivers maximum volume of air, quietly
One-piece, welded, aluminized steel HEAT EXCHANGER
Adjustable LOUVERS control distribution of warm air
Welded, leakproof aluminized steel COMBUSTION CHAMBER
Grey enameled, bonderized heavy gauge steel CASING
Quiet, standard, single phase, 60-cycle, 115-volt MOTOR
Interchangeable, cast iron BURNERS for various gases
Automatic PILOT safety switch . . . temperature LIMIT control
Shut-off VALVE in pipe connection ahead of controls



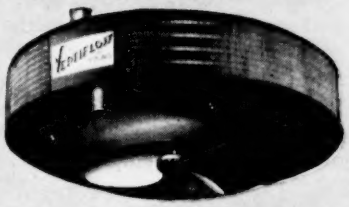
GAS-FIRED

Unit Heaters are available in 7 sizes; 70,000 to 230,000 Btu's; AGA-approved for all kinds of gases.

Other Young Unit Heaters for Steam or Hot Water Systems

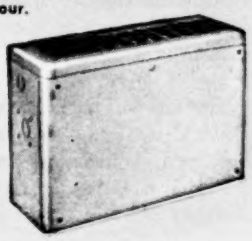
"VERTIFLOW"

Unit Heaters for vertical air discharge are available in 7 sizes—in capacities from 52,600 to 552,000 Btu's per hour.



HORIZONTAL

Horizontal type Unit Heaters are available in 14 sizes . . . in capacities from 19,000 to 325,000 Btu's per hour.



CABINET

Cabinet Unit Heaters, available in three basic styles with capacities from 32,000 to 115,000 Btu's per hour, are used in auditoriums, lobbies, recreation halls, etc.

Pioneers in the Heat Transfer industry for more than 25 years, Young Radiator Company now offers you an efficient, dependable and economical Gas-Fired Unit Heater in seven sizes, ranging in capacities from 70,000 to 230,000 Btu/hr. input.

Attractive and modern in appearance, the units feature all welded, aluminized steel combustion chambers and heat exchangers which withstand the corrosive effects of gases and high temperatures, causing discoloration or destructive scaling. This feature alone adds many years to the service life of the Young Gas-Fired Unit Heater. For extra protection against corrosion, the heavy-gauge steel casing is bonderized before enamel is baked on.

Other Young Unit Heaters, available for steam or hot water systems, include the "Vertiflow," Horizontal and Cabinet models. For further details or catalog, see your Young Representative or write direct.

YOUNG

Heat Transfer Products for Automotive and Industrial Applications.

Young Quality

T. M. Reg. U.S. Pat. Off.

Heating, Cooling, Air Conditioning Products for Home and Industry.

YOUNG RADIATOR COMPANY

Dept. 523-C

Racine, Wisconsin

BRIEFLY STATED

• The election of A. R. Fisher to the board of trustees of Industrial Hygiene Foundation is announced. Mr. Fisher, president of Johns-Manville Corp., New York, N. Y., has long been active in the promotion of industrial health among workers. Appointments to the Foundation's legal committee have also been announced. New members are E. C. Starkey, office of general counsel, Ford Motor Co., Detroit, Mich., and Clarence G. Johnson, regional claims manager, Employers Mutual Liability Insurance Co. of Wisconsin, New York, N. Y.

• Neil T. Chadderdon has been elected a member of C. A. Dunham Company's board of directors. He replaces L. C. Murtaugh, whose position as board secretary was filled by a re-elected member, L. D. Mandell, vice-president and assistant to the president. Mr. Chadderdon is president of Diamond Products Co., Marshalltown, Iowa. He also is a director of Fidelity Savings Bank.

• Appointment of Chester A. Barbeck, formerly of Carrier Corporation's Dallas office, as product promotion manager for its self-contained Weathermaker units with headquarters in Syracuse, N. Y., has been announced. During the past four years he has served as merchandising manager in his district. He specialized in sales engineering with the Servel Company from 1933 to 1942, taking part in the development of home air conditioning. From 1942 to 1945 he was with the War Department as assistant chief of the air conditioning and refrigeration section in the Washington office of the Chief of Engineers. In 1945 he became Dallas district manager of Airtemp Div., Chrysler Corp., leaving this post in 1949 to attain the position he held prior to this appointment.

• At a meeting of the directors of Builders Iron Foundry, Earl H. Bradley was elected president to succeed Henry S. Chafee. Mr. Chafee will remain as treasurer of the company. Mr. Chafee joined the company in 1909, was elected secretary in 1913, assistant treasurer in 1917, treasurer in 1930, and president in 1944. Mr. Bradley came with the firm in 1934 and has served in capacities of shop superintendent, general superintendent, works manager, vice president, and in 1949 was appointed executive vice president. Before joining the company, Mr. Bradley was a partner in Miner-Bradley Manufacturing Company and also an experimental engineer with Brown & Sharpe Manufacturing Company.

• Crane Company's heating division has added three men to posts in its general office staff. The men were all promoted from within the Crane organization. They are: Charles E. Towner, assistant to the vice president; Eugene P. Allen, manager of the heating department; and Edwin B. Cole, manager of the newly-created purchased heating department. Mr. Towner formerly was supervising engineer in charge of thermal laboratory, joining the company in 1937. Mr. Allen moves to the general office staff after having been manager of the heating department at Seattle. Mr. Cole, who started with the firm in 1949, was in the Miami and Jacksonville, Fla., sales branches.

• Ray O. Reeves, sales manager of Airtherm Mfg. Co., St. Louis, Mo., was elected president of Convector Manufacturers Association at their annual meeting. W. R. McMahon of Modine Manufacturing Company was named vice president, and George W. McCormick, Jr., was elected secretary-treasurer.

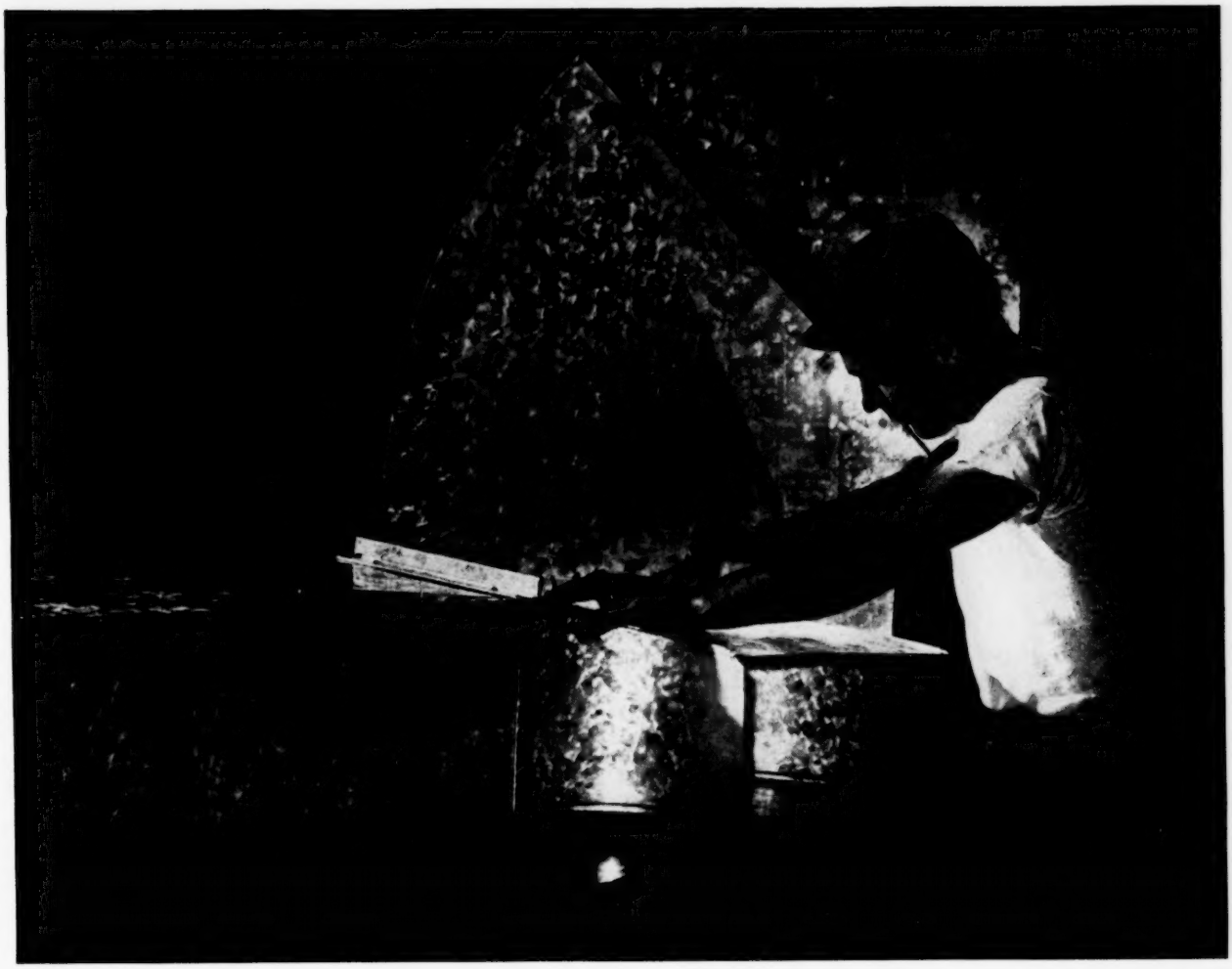
• William G. Christy, until recently director of Bureau of Smoke Control, New York City, has announced that he has severed his connection with the Bureau and opened an office as Consulting Engineer at 34 Park Row, New York City. He has had many years' experience in air pollution and smoke control work, as well as in power and heating plants. In 1925 he helped organize the Citizens Smoke Abatement League of St. Louis and became its executive secretary. In 1930 he organized the first county smoke regulation department in the country. In 1950 Mr. Christy was appointed director of the New York City Bureau. Mr. Christy has been active in ASME for many years, and he is a past president of Smoke Prevention Association of America and initiated its reorganization into Air Pollution Control Association. Mr. Christy states that he is specializing in problems of air pollution control, combustion, fuel, and refuse burning, and in smoke control.

• Continental Steel Corp., Kokomo, Ind., has announced two new appointments in its sales department. Howard C. Williams, sales manager of the sheet division, is elevated to general sales manager, and F. A. Lewis, sales manager of chain link and ornamental fence division, is advanced to sales manager of the merchant trade division. Mr. Williams started with the firm in 1934 and has held various positions in the sales department until his previous appointment in 1946. Mr. Lewis held his first position in the open hearth and metallurgical departments of Corrigan-McKinney Steel Company in Cleveland, joining his present firm in 1930 as a district sales manager.

• A joint announcement by Warren Webster & Company and The Ric-wiL Company has been made covering changes in New York representation which became officially effective January 1. The Ric-wiL Company has established a separate New York organization, with John F. Hanbury as manager and Carl G. Mencke as assistant manager. Mr. Hanbury formerly represented both of the companies. The new Ric-wiL office is at 215 East 37th Street. Warren Webster & Company will continue its office at 95 Madison Avenue, and Kenneth C. Steeneck has been appointed to succeed Mr. Hanbury as district representative.

• Iron Fireman Corp., Cleveland, Ohio, announced the promotion of S. H. Beach to industrial sales manager. Mr. Beach was graduated from Case Institute of Technology, Cleveland, in 1925. After engineering experience in the petroleum industry, he joined the company in 1933 as a field engineer.

• Ronald E. Daniels, vice president and secretary of Federal Portland Cement Co., Inc., of Buffalo, N. Y., has been elected new president of the National Mineral Wool Association, coast-to-coast industrial group which includes manufacturers and distributors of home insulation and other building products.



The WORKABLE SHEET *is Galvanized Steel*

Bethlehem Galvanized Steel Sheets are simple to fabricate. They can be cut, formed, seamed and soldered with no difficulty, using ordinary shop tools. Smooth, good-looking sheet-metal jobs can be done in minimum time.

These easy-working sheets are made of strong, durable steel, either plain or copper-bearing. A spangled zinc coating protects them against corrosion. Their cost is low, and they give excellent service. Dollar for dollar there are no better sheets for all-around work than Bethlehem Galvanized Sheets.

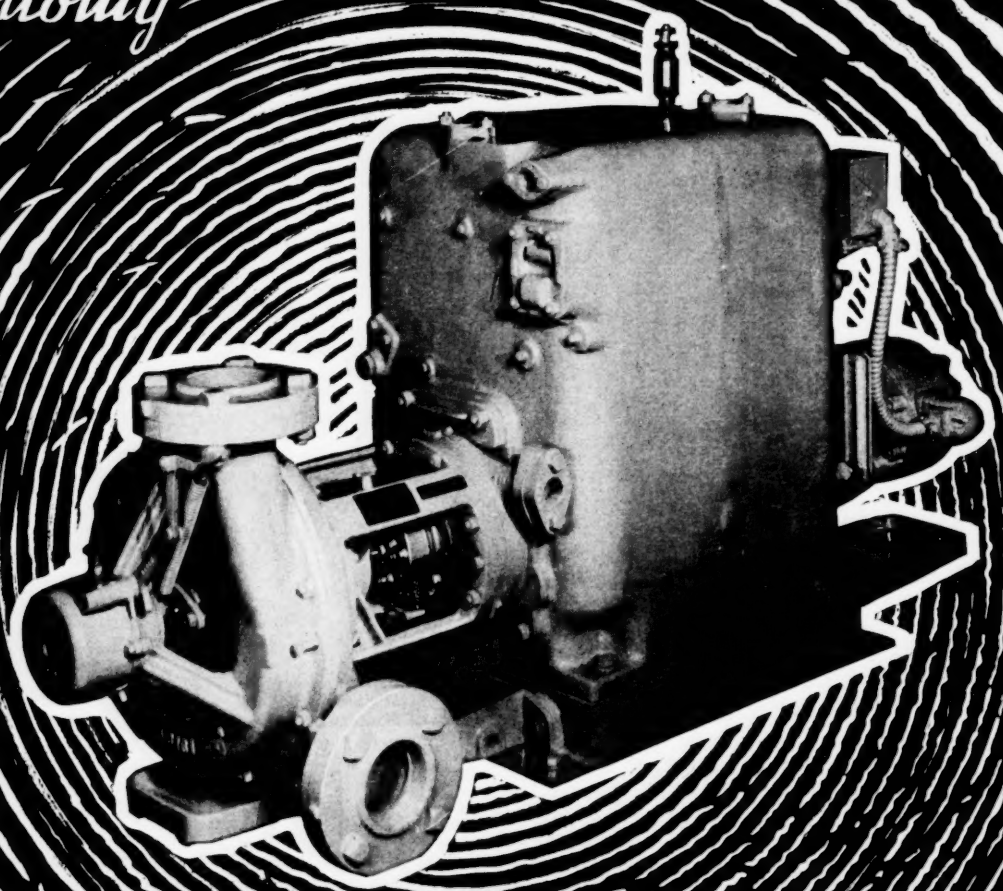
Bethlehem
GALVANIZED
Steel Sheets

★ BETHLEHEM STEEL ★

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

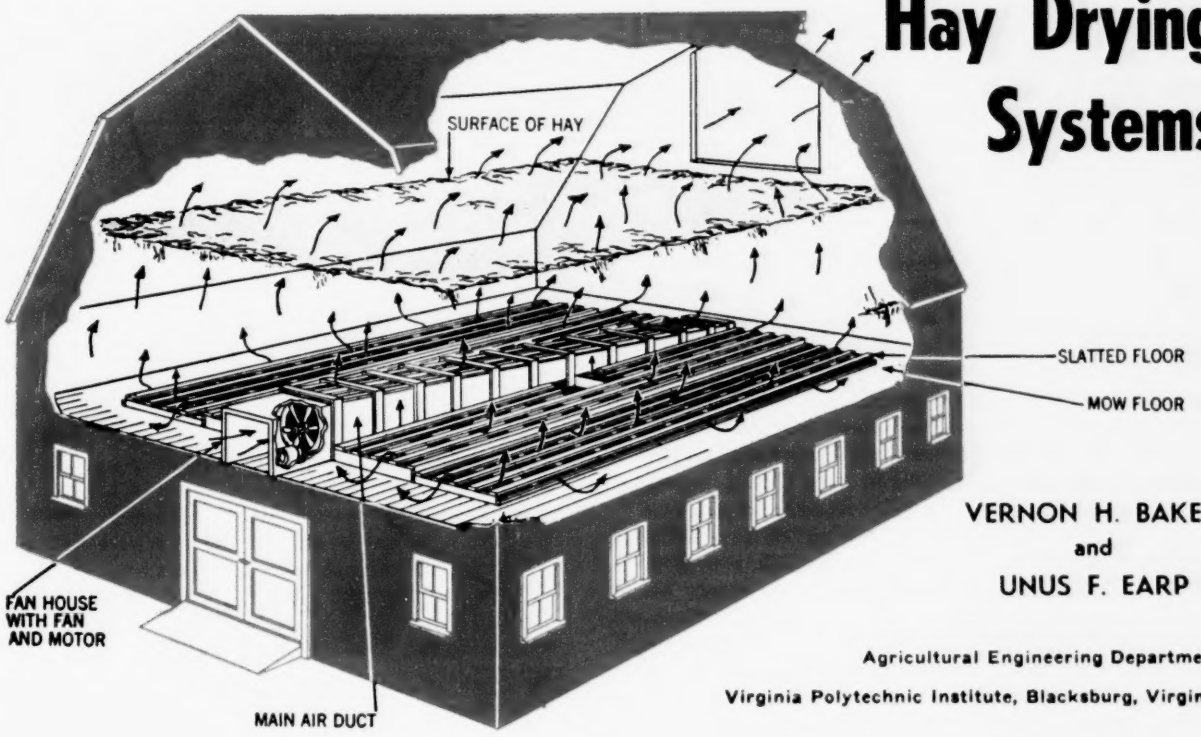
This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

Design of Hay Drying Systems



VERNON H. BAKER
and
UNUS F. EARP

Agricultural Engineering Department
Virginia Polytechnic Institute, Blacksburg, Virginia

What does hay drying mean to the air conditioning equipment business? At the end of 1951, there were some 10,000 hay drying installations in the United States. Even the smaller installations generally require a fan capable of delivering a minimum of around 12,000 cfm; an electric motor having a rating of at least three hp; controls for the motor; an engineering design for the installation; an installation job; and adequate maintenance and service facilities. In larger installations the fan and motor sizes may increase to 7½ or 10 hp. Hay drying systems provide insurance against inclement weather, and cows give more milk when fed barn cured hay, especially when heated air is used for drying. Equipment and structural requirements are discussed in this first part of a two-part article.

THE main factors to be considered in the design of a hay drier are summarized in the following paragraphs.

Amount and Kind of Hay Grown:—The quantity of hay produced on a farm and especially the maximum amount of hay that must be dried at one time determine the size of drier required.

Alfalfa is well adapted for artificial drying, since it is usually harvested in three to five cuttings each year, and the drier is in use a large portion of the summer. If a drier is designed to handle the first cutting, it will be of ample size for future cuttings. For design purposes, an estimated first cutting yield of 1½ tons per acre may be assumed. For other hay crops the drier should be designed to handle the maximum amount of hay to be harvested within a one- to two-week period.

Density of Hay:—The density in pounds per cubic foot and volume occupied per ton for long, chopped, and baled alfalfa hay are shown in Tables 1, 2, and 3.

As shown in these tables baled hay is more dense than long or chopped hay, therefore, air is forced through it less easily. It is for this reason that more satisfactory drying will result if baled hay is allowed to dry in the field to 35% moisture before baling. Long and chopped hay may be loaded on the drier at 40 to 45% moisture.

Amount of Water to be Evaporated From Hay:—The maximum moisture content of hay for safe storage is 20%. The amount of water to be evaporated from hay containing various amounts of moisture to provide safe storage conditions is shown in Fig. 1. It is seen that about 909 lb of water must be removed from 45% hay in order to have a ton at 20% moisture. Similarly, approximately 462 lb of water must be removed from 35% moisture content hay in order to have a ton of 20% moisture hay.

TABLE 1—DENSITY OF HAY AND REQUIRED AIR FLOW

Hay Condition	Volume, Cu Ft per Ton	Density, Lb per Cu Ft	Min. Air Flow, CFM per Ton
Long Loose or Chopped	310	6.45	500
Baled	300	6.70	600

Values are averages for drying system design purposes. Density will vary with hay type, moisture content and depth of storage.

TABLE 2—APPROXIMATE AREA AND VOLUME OCCUPIED BY BALED HAY
(20% Moisture, Wet Basis)

Size of Bale in Inches	Volume[1] of Bale, Cu Ft	Approx. Vol., Cu Ft per Ton	Approx. No Bales per Ton	Floor Area[1], Sq Ft Occupied; per Bale on Edge in Drier
16 x 18 x 36	7.50	300	40	4.6 sq ft
14 x 18 x 36	6.65	300	45	4.0 sq ft

[1]Adjusted to allow for expansion of bale after removal from baler and for distance between bales when stacked on drier. Bales stacked on 18-inch sides will occupy about 5.12 sq ft floor space per bale.

Natural Air and Supplemental Heat:—Most present installations use forced natural air for hay drying, but there is an increasing interest in the use of supplemental heat especially for drying baled hay. The reduced drying time with supplemental heat makes it possible with a given size of drier to dry a larger quantity of hay during the season than is possible with a natural air system. Also better drying results can usually be obtained in bad weather when supplemental heat is used. With a 7½ hp fan unit using unheated air the maximum capacity is about 1600 bales or 40 tons of hay per cutting. If the quantity to be dried exceeds this amount, it is well to consider the use of supplemental heat. This is true because two natural air systems may be more expensive to install than a single unit using supplemental heat.

If the farm has a suitable building which provides adequate space for the drier, consideration should be given to using forced natural air. This type of system will usually be lower in first cost and usually it can be expected to give satisfactory results. If, on the other hand, no suitable building is available, and if hay is stored and fed in two or more places on the farm, it may be advisable to use a portable crop drier. With this drying unit, the hay can either be dried on a portable wooden rack in the field, or it can be dried in an inexpensive shed built for the purpose. Also, if a farmer plans to dry such other crops as corn and small grain, he should consider the purchase of a portable crop drier with supplemental heat.

Fuel Cost:—The cost of fuel oil for drying hay having various moisture contents is shown in Fig. 2. It will be noted that the cost of drying rises rapidly when the moisture content exceeds 50%. There is under development a coal burning unit, and there is one which uses gas, but most crop driers now on the market, use oil as a fuel. Direct and indirect models with gun-type oil burners are shown in Fig. 3 and 4. An indirect design with pot-type burner and simpler heat exchanger is also made. Typical control system for the Fig. 4 unit is shown in Fig. 5.

Location of Drier:—A hay drying system can be placed in any structure which provides adequate space, protection from the weather, proper drainage and ventilation,

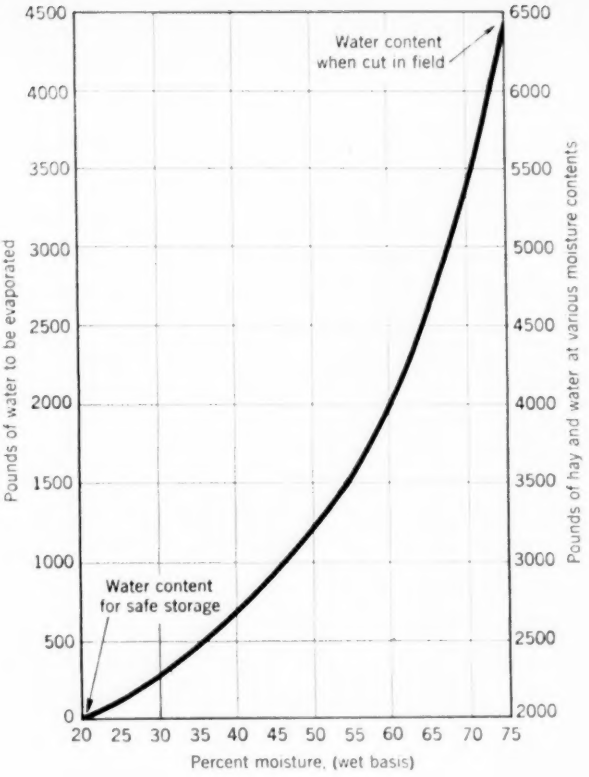


Fig. 1. Pounds of water to be evaporated from hay of 20% to 75% moisture to make one ton of hay at 20% moisture.

and a minimum of obstruction in the mow. Driers can be installed in hay mows above ground or at ground level. If a special structure is to be built for the drier it should be planned to serve other purposes also if possible. For example, such a building may be used for the storage of farm machinery during the winter months, or for drying other crops.

Good drainage is of great importance for installations at ground level. If surface drainage water or other excessive moisture is permitted to enter the area occupied by the drier, the effectiveness of the system will be reduced. Where possible the drying area should be located at a level above the natural grade line.

Air Distribution Systems

A forced air hay drying system must provide a means of delivering air from the fan to the storage area and then properly distributing this air throughout the hay mass. Several distribution systems which are in use will be described briefly as follows:

Slatted Floor System:—Fig. 6, which appears at the

TABLE 3—WEIGHT AND DENSITY OF BALES AT VARIOUS MOISTURE CONTENTS

Size of Bale in Inches	Percent Moisture, Wet Basis									
	20%		30%		40%		50%		60%	
	Lb Weight,	Lb per Cu Ft	Lb Weight,	Lb per Cu Ft	Lb Weight,	Lb per Cu Ft	Lb Weight,	Lb per Cu Ft	Lb Weight,	Lb per Cu Ft
16 x 18 x 36	50.0	6.7	57.1	7.6	66.7	8.9	80.0	10.7	100.0	13.3
14 x 18 x 36	45.0	6.7	51.4	7.6	60.0	8.9	72.0	10.7	90.0	13.3

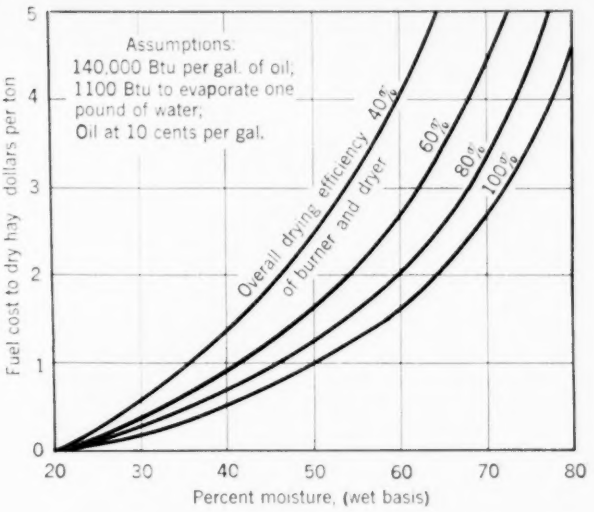


Fig. 2. Approximate fuel cost for drying hay with oil heat. Note that for oil at, say, 12 cents per gallon, cost from graph should be multiplied by 1.2.

head of this article, shows the general layout of a slatted floor system for long or chopped hay. An orifice at the floor level on the side of the main duct meters air to the stationary slatted floor sections. Another orifice at the junction of the movable and stationary slatted section meters air to the movable slatted section. It is well suited to some of the wider hay mows. The main duct may be either the tapered type or the rectangular type.

A slatted floor system for baled hay using an underground main air duct (Fig. 7) is suitable for installations at ground level in well drained areas. With this system, a level slatted floor with two-foot border of solid floor makes the problem of stacking and removing bales much easier. Removable slatted floor sections may be placed on either a dirt or concrete floor, but if placed on dirt should be supported on treated lumber. The main air duct should have a concrete floor and either concrete or masonry sidewalls. The duct floor should taper upward so that the duct will be about 10 inches deep at the end farthest from the fan.

Slatted floor systems, for drying baled hay, having a center main duct with constant cross section above floor level (Fig. 8), are limited primarily to situations where

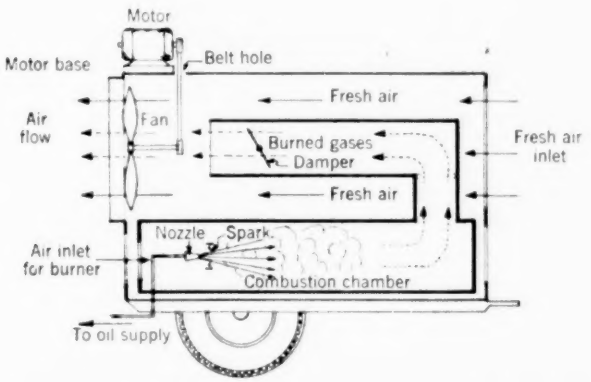


Fig. 3. Cross section of direct type crop drier.

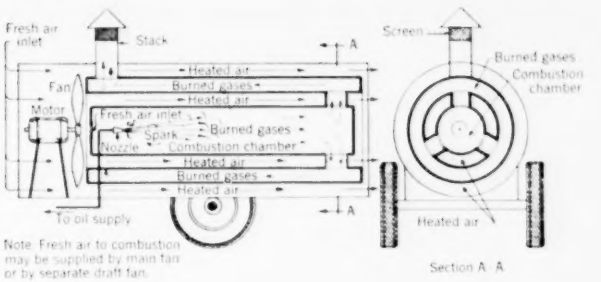


Fig. 4. Indirect crop drier with heat exchanger.

the drier can be loaded and unloaded from both sides. With this arrangement a dry batch may be removed from one side while a batch is being dried on the other side. It is doubtful if this method of loading the drier is of value when forced natural air is used. With heated air, however, it can be quite effectively used since two drying areas can be operated from one drying installation. If the drier is to be operated in sections, regulating gates are placed in the main duct so that air may be supplied to the proper section. With the constant cross section duct these gates are more readily accessible for adjustment.

Main ducts may be constructed along one side of the mow and may be of either the constant cross section or the tapered type. Side types provide for a level slatted floor on which bales may be stacked and the duct is located so as not to interfere with the loading and unloading operations. These are especially well adapted for baled hay drying in above ground mows or in special hay drying sheds at ground level which may be in poorly drained areas.

Center Duct, (Without Slatted Floor):—Fig. 9 shows the general arrangement of the center duct type of system. The air supplied to the center duct is distributed to the hay from this main duct without the aid of any type of auxiliary floor distribution system. It is applicable to narrow hay mows and may be built in rectangular or triangular shape. The triangular duct is generally referred to as the "A" frame drier and is adaptable to long or chopped hay. The center rectangular duct is adaptable to baled hay although long or chopped hay may also be dried on such a system. In any event, provisions should be made for the air to travel equal distances through the hay.

Plenum Chamber:—Air may be delivered to an underfloor plenum chamber from which it diffuses through either a perforated metal floor, a wooden slatted floor, or a floor of hardware cloth covered with screen wire. No main duct is needed, but an adapter is required to connect the crop drier or fan to the plenum chamber.

Pipe Systems:—Fig. 10 shows the general layout of a

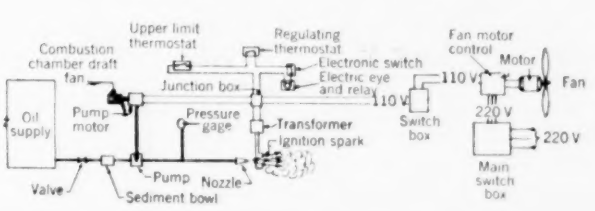


Fig. 5. Control diagram for drier shown in Fig. 4.

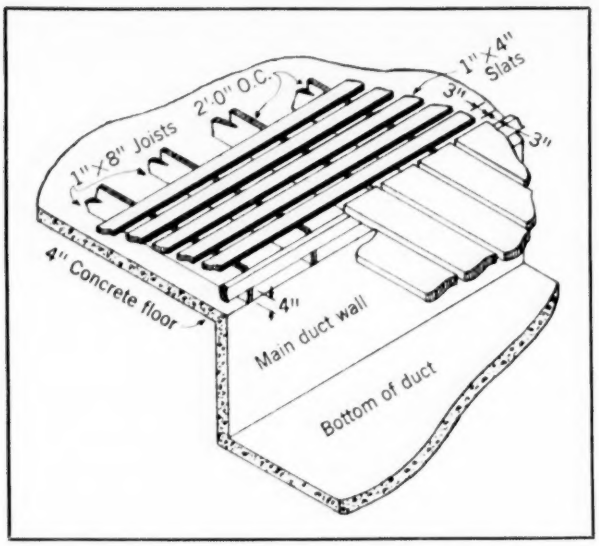


Fig. 7. Arrangement of duct below ground level.

so called pipe system. Air is delivered to vertical flues through the main duct. The tops of the flues are capped off with stovepipe or wooden formers with closed ends to which handles are attached. As the hay is loaded in the mow, the pipes are raised vertically allowing air to move into the hay near the lower end of the pipe. As additional hay is added to the mow the pipes are again raised leaving a flue in the hay below through which air may be conveyed to the bottom of the pipe and again be distributed to the hay mass. This system is being used in some parts of the country in many of the narrow deep hay mows where the final depth of hay (long or chopped) often extends from 15 feet to 25 feet or more.

Field Driers:—It is generally considered that field driers should be used only with supplemental heat. Fig. 11 shows the layout for one field drying unit. A slatted floor or center duct type of distribution system seems most practical generally speaking. The slatted floor type lends itself exceptionally well to these field drying units especially for drying baled hay. The wooden rack provides a simple method of distributing the air and it can be built in sections for portability. A tarpaulin of sufficient size to cover the hay should be supplied to protect the hay from the elements. Also it causes the air to sweep the outsides of bales thereby improving the drying efficiency. Since most farmers might be expected to prefer a more permanent arrangement, it is considered that this type has rather limited application.

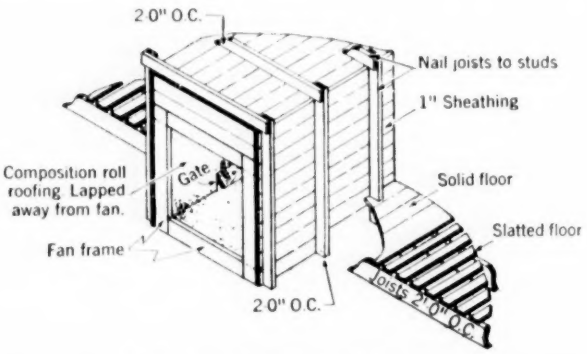


Fig. 8. Center duct above floor level.

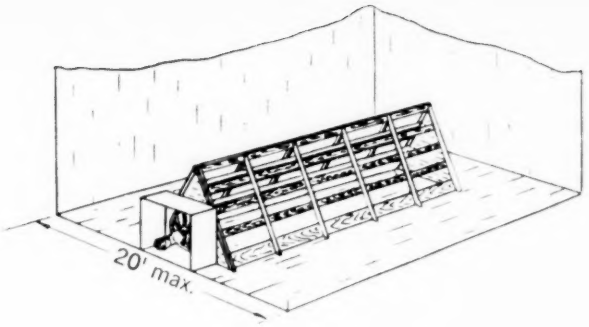


Fig. 9. Center duct without slatted floor.

Commercial Hay Makers:—Most commercial units consist of a tall bin or silo with a vertical center duct. Long or chopped hay is loaded from the top. Air is forced in through the center duct, out through the hay, and is discharged through openings on the sides of the structures. Air regulating gates in the center duct permit drying a loading at a time. Since these units are generally not custom designs, they are outside the scope of this paper.

Fan Types

Centrifugal, vaneaxial, and propeller type fans may be used in hay driers. The propeller type is the one most commonly used on portable units, and many are used in permanent installations. The vaneaxial type has good operating characteristics for hay dryer installations, but it is usually more expensive than some of the other types and this fact tends to limit its use.

The centrifugal fan is made in two types, the forward- and backward-curved blade. The backward-curved fan will not place an overload on the fan motor if the air pressure is reduced, whereas the forward-curved fan may overload the fan motor, if the air pressure is reduced. For the same capacity the backward-curved fan is more costly than the forward-curved fan since it must be built stronger to operate at a higher speed.

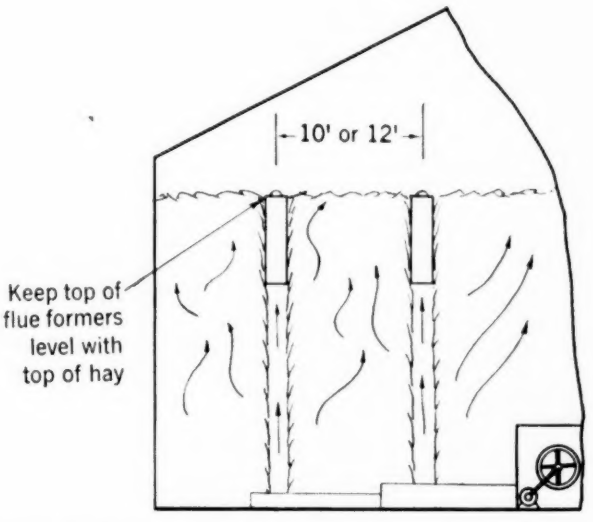


Fig. 10. Capped vertical flues improve air distribution and lower resistance of deep loose hay.

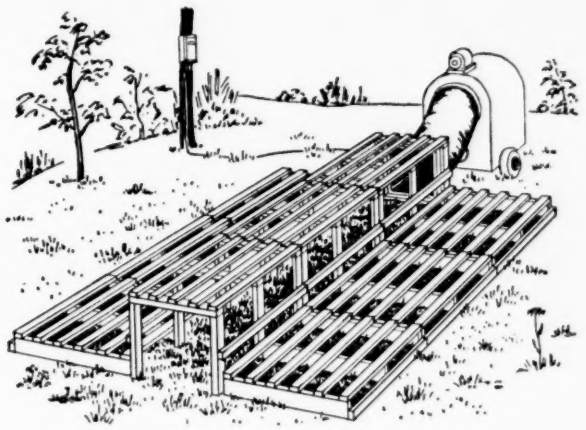


Fig. 11. Field drier.

Portable crop driers come equipped with the fan mounted in the unit. In determining the capabilities of a crop drier, the cfm rating of the drier as a unit (not of the fan alone) must be used.

Air Flow and Pressure Relationships For Selecting Fans:—Research and field experience have shown that the following air flow values are minimum for loose or baled hay:

A static pressure of ¾ inch w.g. is necessary to force 20 cfm of air per sq ft of mow floor through 6 layers of baled hay with a moisture content of 35%. Greater depths may possibly be dried if the moisture is considerably less than 35% wet basis. The following static pressures are necessary to force 15 cfm per sq ft of mow area through various depths of 40% moisture long and chopped hay:

Hay Depth, Feet	S. P., Inches w.g.	Hay Depth, Feet	S. P., Inches w.g.
5	½	15	1
7	¾	20	1⅛
10	¾	23	1½

These estimates are based on the assumption that the air is moving vertically through the entire depth of hay from a slatted floor or laterals. The loading depth indicate the amount of hay with the specified moisture content that may be put on the drier in a one to three day period using the minimum air flows indicated. An additional layer of long and chopped hay may be placed on top for drying when the batch beneath it has been dried or has almost dried. If this is done, however, higher static pressures may be required in some cases since air would have to be forced through a thickness of dried hay as well as through the new layer to be dried. Static pressures listed are minimum values. It is not recommended that baled hay be dried with one batch on top of the other.

Next month, the authors will discuss the equipment required including the fan, motor, and controls. Design examples will be presented.

Construction Level Depends on Air Conditioning

The current interest in residential cooling is based squarely on economic necessity. The acute post-war housing shortage is over. The formation of new families has decreased from 1,200,000 in 1948 to about 600,000 this year, and the building industry is geared to produce over a million homes a year. As a result, builders must now create a replacement market for nearly half the homes they build; if they are to continue building at present rates.

This opinion was expressed by L. M. Larkin, regional manager of the central division, Air Condition Div., General Electric Co., during a recent talk before members of the Illinois Chapter, ASHVE.

After citing various housing projects where summer cooling was included, Mr. Larkin stated that sales in 1952 demonstrated to builders that year 'round residential air conditioning is a practical sales tool and bids to obsolete new homes without it. In his opinion, this year will mark the beginning of a complete revolution in the marketing of packaged heating and air conditioning equipment. One group of manufacturers whose experience has been basically in cooling will market its equipment through its existing air conditioning outlets. Another group of manufacturers will market its equipment through heating and cooling jobbers. The largest group of manufacturers, by far, will be the heating equipment manufacturers having literally tens of thousands of dealers across the country.

The second speaker of the evening was R. T. Hansen, central regional manager, Acme Industries, Inc., who discussed the technical and design aspects of residential air conditioning. After reviewing the industry's experience prior to 1952, Mr. Hansen outlined some of the lessons learned during these past years and stated that those contractors who have installed residential air conditioning have contributed a great deal of knowledge and experience which will serve this vast new market in many ways.

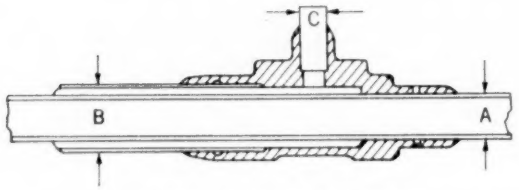
He pointed out that last year several forces came together at the same time to require a new program for equipment, engineering, applications, products, and prices. For example, the builder has suddenly turned to air conditioning for his houses as a necessary sales feature, and the architect has come forth with economies in construction which permit the addition of air conditioning within the budget of competitively priced homes.

Mr. Hansen also mentioned the fact that today a variety of equipment is available. This includes packaged year 'round conditioners, packaged refrigeration cooling units designed for use with a new or existing forced warm air furnace, and packaged water chiller units used with individual forced air convectors which are designed for cooling with chilled water and heating with hot water.

Technical aspects which are and will be factors in residential air conditioning sales were said to include available space for equipment in some types of houses, water supply, the wide range in outside design conditions—as it affects equipment design, humidity control, limitations of furnace fan capacities, diffusion of cooled air in rooms, serviceability of equipment, and the development of simplified procedures for sizing equipment.

Suction Gas Superheaters for Freon-12 Systems

This article, prepared by engineers of York Corp., York, Pa., discusses the use of suction gas superheaters for improving refrigerating effect. Graphs are presented and illustrative problems used to show how to select superheaters of double pipe and shell and coil types. Data in this article are to be used in conjunction with piping hookups for double pipe and shell and coil types of suction gas superheaters illustrated on pages 9 and 10.



A = Suction main outside diameter
B = Superheater jacket outside diameter
C = Liquid bypass line outside diameter

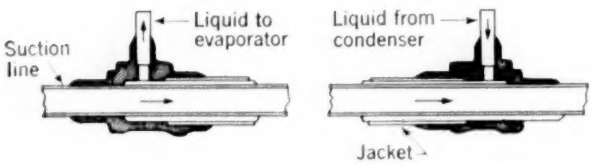


Fig. 1 (above). Streamline heat interchanger tee.

SUCTION gas superheaters used in thermal valve-fed refrigeration systems insure that dry refrigerant gas is delivered to the compressor; better operation of the compressor is promoted; and refrigeration effect per pound of refrigerant flowing is increased. Superheaters increase evaporator efficiency by providing the necessary suction gas superheat to operate thermal expansion valves if only a portion of the circulating refrigerant is passed through the heat exchanger as shown in the illustration on pages 9 and 10.

When suction gas superheat must be provided by the evaporator, a portion of the evaporator does not operate at its maximum refrigeration effect.

Superheaters for use with thermal valve-fed evaporators are available as double pipe and also shell and coil types. Heat exchanger connections for the double pipe design are shown in Fig. 1. They are field assembled by slipping hard drawn copper tube of desired length and diameter over a portion of the suction line with two solder type brass heat exchanger tees.

Advantages and Limitations of Superheaters

In summary the use of suction gas superheaters results in the following advantages:

(1) Serves as suction gas drier and prevents liquid refrigerant from passing to the compressor during the normal hours of operation of the refrigeration systems.

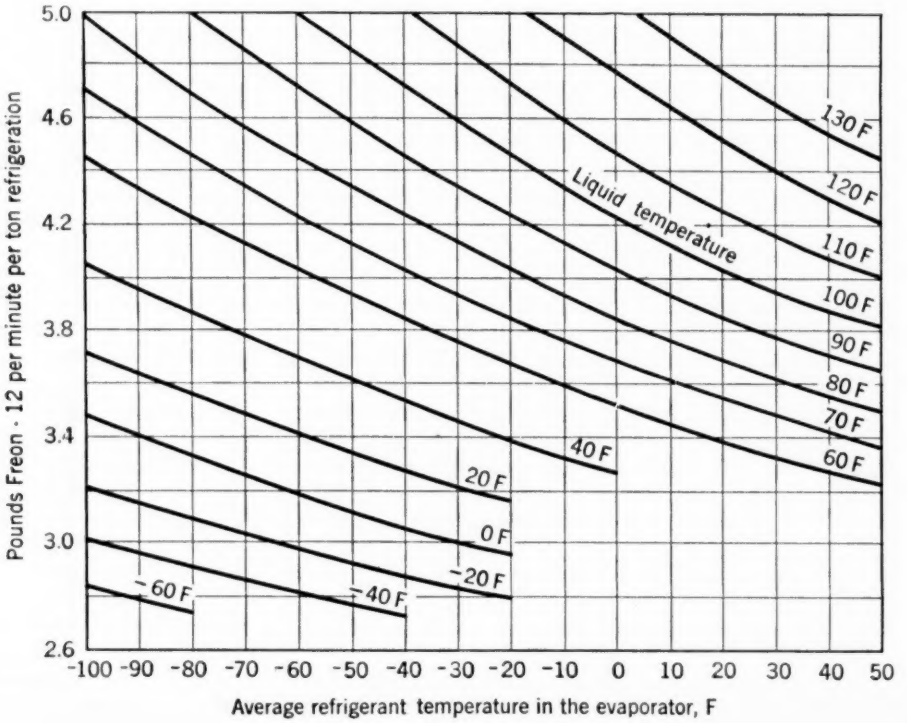


Fig. 2 (right). Refrigerant flow rate for Freon-12.

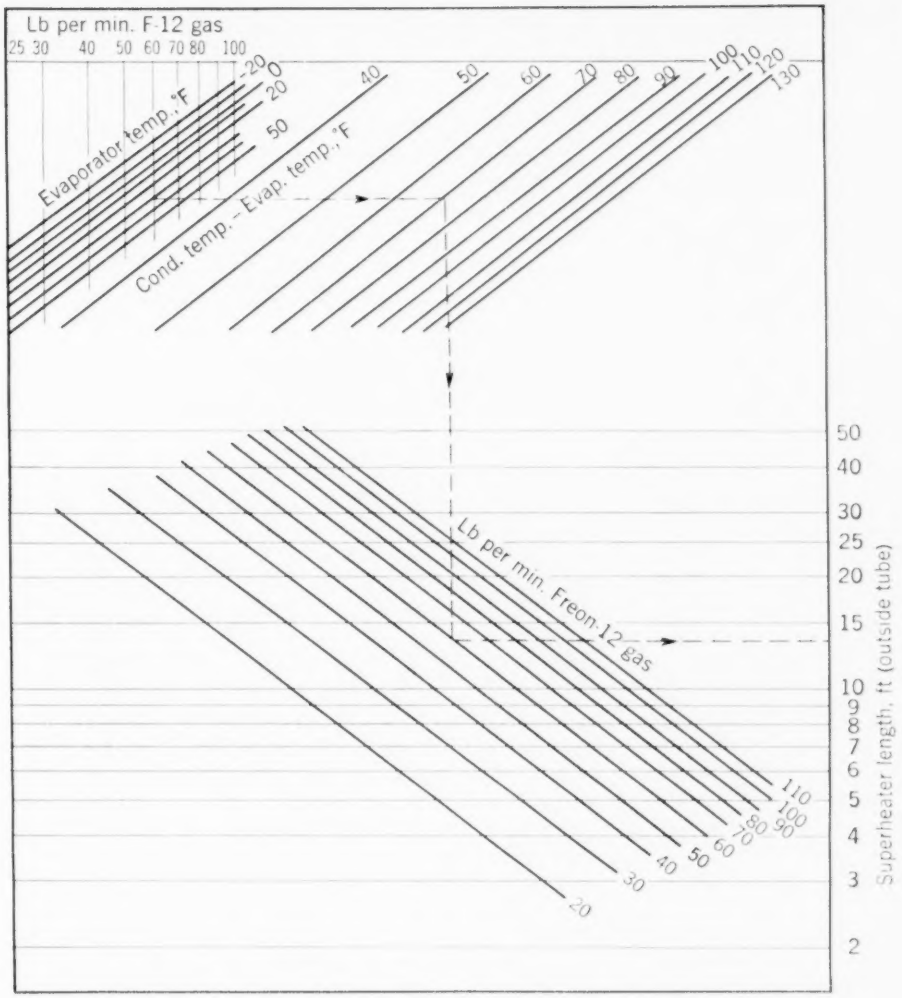


Fig. 3. Superheater ratings for 2⅛ x 2⅝-inch double pipe superheater.

(2) Refrigeration effect per pound refrigerant flowing is increased. No sacrifice is made in refrigerant capacity, since the heat used to dry and superheat the suction gas is taken from the liquid refrigerant supplying the evaporator, thus reducing the amount of flash gas required to cool the liquid to evaporator temperature.

(3) Increased evaporator efficiency. There is no sacrifice of evaporator capacity to provide the necessary superheat for operation of the thermal valve.

The two types of superheaters have limitations which cannot be overlooked when selecting a superheater for a specific application:

(1) A minimum differential of 40F is required between condenser and evaporator refrigerant temperatures to provide sufficient heat for superheating the suction gas.

(2) The size of a double pipe superheater should be equal to the size of the suction line, which is turn is selected after considerations of length, tonnage and pressure drop.

(3) Practical considerations normally limits the use of double pipe superheaters to 20 tons of refrigeration. Above this tonnage, shell and coil superheaters are employed.

(4) A single evaporator is limited to the use of not more than two superheaters—a total of 120 tons. For evaporator capacities greater than 120 tons, special design superheaters are necessary.

Method of Selection

Various charts have been developed to simplify the selection of suction gas superheaters.

Fig. 2 shows the pounds of refrigerant circulated per minute per ton refrigeration for various evaporator and condenser temperatures. The total pounds of refrigerant circulated per minute may be found by multiplying the value read from this figure by the design tonnage of the evaporator.

Fig. 3 gives the required length of double pipe superheaters to handle various tonnages. Charts for other sizes will be published in the following issue. These design charts are based on:

(1) Size of suction line which forms the inner pipe of the superheater.

(2) Pounds per minute of Freon-12 gas that passes through the suction line.

(3) Difference between condenser and evaporator temperatures.

(4) Sufficient heat transfer surface to superheat suction gas 10F with an additional 60% surface to evaporate liquid slopover.

Fig. 4 presents the suction gas pressure drop through a given size shell and coil superheater based on the evaporator temperature and the pounds per minute of refrigerant gas that passes through the superheater. The piping hookup (pages 9 and 10) permit 20% of the full load of refrigerant liquid to flow through the heat exchanger. The design charts are based on this flow.

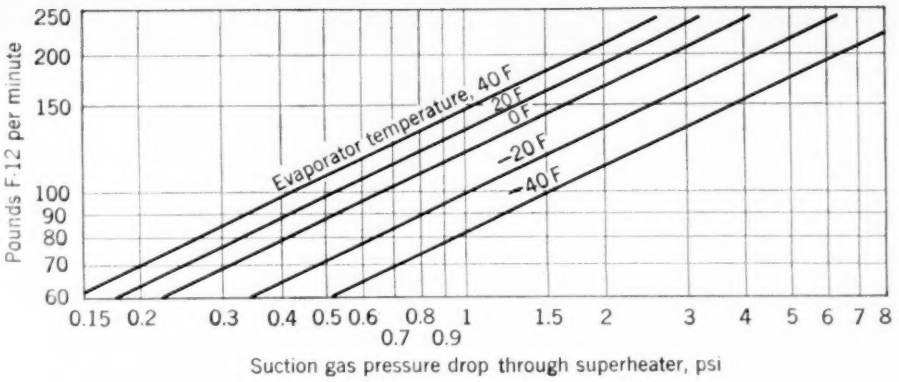


Fig. 4. Suction gas pressure drop for shell and coil superheater.

In selecting the size superheater required, the following facts must be known: Tons refrigeration capacity of system; condensing refrigerant temperature; evaporator refrigerant temperature; diameter of suction line.

Selection of Double Pipe Superheater

Problem: Let us select a double pipe superheater for the following design conditions: Water cooling system with 15 tons capacity; 100F condensing refrigerant temperature; 30F evaporator refrigerant temperature; 2⅛-inch O.D. suction line.

Solution: From Fig. 2 we find that for 30F evaporator temperature and 100F condenser temperature, there must be a flow of 3.96 lb Freon-12 per minute per ton refrigeration. For a 15-ton installation, the amount of refrigerant required is 3.96 x 15 or 59.4 lb per minute of refrigerant. For a 2⅛-inch suction line, the 2⅛-inch x 2⅝-inch superheater will be used. Using Fig. 3, we find 59.4 on the Lbs per Min. F-12 Gas scale in the upper left corner, drop to the evaporator temperature of 30F then move over to the temperature difference of 70 (100 — 30), drop down to the Lb per Min. Freon-12 scale at the bottom of the chart, then over to the right to find that the superheater must be 13.5 ft long. This solution is indicated in Fig. 3 by the dotted line.

No attempt is made to select and fabricate shell and coil superheaters to fit exact conditions of a specific application. Field application on shell and coil superheaters has resulted in the standardization of a single size shell and coil superheater. This superheater is made available to handle evaporator tonnages up to a maximum of 60 tons. Above this requirement, 2 superheaters are employed to handle evaporators up to 120 tons. Therefore, the selection of a shell and coil superheater is simplified and resolves itself merely to the determination of suction gas pressure drop through the shell of the superheater.

Problem: Select a shell and coil superheater for a system which has a water cooling system capacity of 48 tons; 100F condensing temperature; 30F evaporator temperature.

Solution: As in the first problem, Fig. 2 shows that for 30F evaporator temperature and 100F condenser temperature, 3.96 lb Freon-12 must be circulated per ton refrigeration. For 48 tons, there must be 3.96 x 48 or 190 lb refrigerant per minute. From Fig. 4 we learn that for a 30F evaporator temperature and a flow of 190 lb refrigerant per minute, the suction gas pressure drop through the superheater shell will be 1.58 psi.

Piping Hookups

On pages 9 and 10 (Fig. *A* to *D*) are shown refrigerant liquid feeding arrangements of superheaters in the refrigerant circuit. Fig. *A* and *B* illustrate the arrangement of double pipe and Fig. *C* and *D* show arrangements for shell and coil superheaters. In each case, part of the warm liquid on the upstream side of the expansion valve is diverted into the superheater to be subcooled. This subcooled liquid is throttled at the throttling valve and joins in the main body of liquid at the evaporator inlet. When one compressor is used without capacity variation, one solenoid valve is sufficient to stop liquid refrigerant flow through the bypass line when the compressor is stopped (Fig. *A* and *C*). When partial compressor capacity or step control is used with any number of compressors, two solenoid and throttle valves should be connected in parallel in the bypass line (Fig. *B* and *D*).

An inset of Fig. *A* shows the proper position of the thermal bulb, with the capillary toward the top of the bulb. When more than one superheater is used, the thermal bulb is connected to the common suction line. Since most of the slopover liquid flows in the bottom of the suction line, it is necessary to detect its pressure and temperature so that the thermal valve pinches off the liquid supply.

When a single solenoid valve is used, it should be selected for 20% of the total full load liquid flow, and the thermal expansion valve should be selected for passing the remainder of the liquid. When two solenoid valves are connected in parallel, each should be selected to handle 10% of the full load liquid flow, the thermal valve again being sized to pass the remaining 80%. The liquid bypass line should be large enough to keep pressure loss to a minimum, since high liquid-to-gas temperature differential is essential to the superheater.

When a single shell and coil superheater is used, the liquid is injected at two points in the bottom of the evaporator, equally spaced between the ends of the shell and exchanger as shown in Fig. *C*. With two superheaters, the liquid enters in the bottom center and the superheaters are mounted above the shell equally spaced between the center and the ends of the shell as in Fig. *D*.

The alternate arrangement of the superheater illustrated in Fig. *C* is necessary when headroom is not available for mounting the superheater on top of the evaporator. This arrangement may also be applied to the double superheater hookup shown in Fig. *D*.

Events at Chicago Convention

Abstracts of some of the papers presented at the 59th annual convention of AHVE, Chicago, and some of the meeting highlights.

EVIDENCE of the growth of the heating and ventilating industry was indicated at the 59th annual meeting of the American Society of Heating and Ventilating Engineers held at the Conrad Hilton Hotel, Chicago, Ill., January 26 to 29 and the 11th International Heating and Ventilating Exposition at the International Amphitheatre.

Left to right, R. F. Taylor, president; L. N. Hunter, vice-president; J. E. Haines, second vice-president.

About 2,600 persons registered at the convention and at the show there were more than 400 exhibitors.

New Officers

The new officers of the society are president, Reg F. Taylor, consulting engineer, Houston, Tex.; first vice-president, Louis N. Hunter, vice-president of research, National Radiator Co., Johnstown, Pa.; second vice-president, John E. Haines, vice-president, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.; treasurer, John W. James, vice-president, McDonnell & Miller, Inc., Chicago, Ill.

F. Paul Anderson Medal

The 1952 F. Paul Anderson medal for "outstanding work in the field of heating, ventilating and air conditioning" was formally presented at the annual society banquet to E. N. McDonnell, president, McDonnell & Miller, Inc., Chicago, Ill.

Mr. McDonnell is active in a number of industry associations including the Institute of Boiler and Radiator Manufacturers, the Steel Boiler Institute, Association of Stoker Manufacturers, Gas Appliance Manufacturers Association and the National Electric Manufacturers Association. He is a director of the Oil Heat Institute and a past treasurer of the Plumbing and Heating Industries Bureau. He serves on the National Board of Boiler and Pressure Vessel Inspectors. During his membership with ASHVE, which dates back to 1923, he has held many key posts and he has served on the ASHVE Council for eight years. Mr. McDonnell has been very active in working for the good of the industry.

Abstracts of Papers

Six technical sessions were held as part of the convention, apart from the special meetings of TAC committees. Following are the abstracts of papers presented during the technical sessions.

Clothing and Temperature Changes

Women adjust as readily as do men to sudden entrance into a hot, humid environment. Their skin temperatures rise promptly, even faster than is observed for men. Sweat is slower to appear than in the case of men. As women leave a hot, humid room and enter one which is normally comfortable, they feel cool, stop sweating promptly, and rapidly adjust their skin temperatures much as do men under such conditions.

These findings were reported in a paper, A Comparison of Physiological Adjustments of Clothed Women and Men to Sudden Changes in Environment, by Tohru Inouye, Dr. F. K. Hick, Dr. R. W. Keeton, J. Losch and Nathaniel Glickman. This research was sponsored by ASHVE, and the United States Public Health Service in cooperation with the University of Illinois, College of Medicine, located in Chicago.

A group of healthy young women were used as subjects. After one hour in a comfortable room, the subjects walked into an adjoining room which was maintained at 98.5F with a 66% relative humidity. After a one-hour exposure in the hot room, they returned to the comfortable room and were observed for an additional hour. During the tests observations were made of body weight, skin and

J. W. James, Treasurer

E. N. McDonnell, Medalist

rectal temperatures, pulse, blood pressure and the subjective feeling of warmth or coolness.

Compression Tank Selection

Divergent results obtained when using various accepted methods for sizing compression tanks that are part of hot water heating systems, adds interest to the paper, Compression Tank Selection for Hot Water Heating Systems, by H. A. Lockhart and G. F. Carlson, respectively, chief engineer and engineer, Bell & Gossett Co., Morton Grove, Ill.

A table was included to facilitate tank selection for conditions adopted as standard. Correction factors for conditions other than standard are included in the selection table. The paper has equations for determining proper tank capacities for various conditions.

The table included shows the maximum tank size required separately for the boilers, radiation, forced circulation piping, and for piping and panels in a radiant heating system. The maximum tank capacity required for a complete system is found by adding the maximum tank capacities required for each component of the system. Maximum tank capacity requirements are based on 22% of the average water contents of boilers, radiation and piping, and adopted standard conditions of 12 psig initial pressure, 30 psig final pressure and 18.5 ft maximum system height above the tank.

The authors included a number of illustrative problems to show how the data may be used to determine tank size.

Bacteria and Odor Control

In his paper, The Bacteria and Odor Control Problem in Occupied Spaces, R. L. Kuehner, research engineer, York Corp., York, Pa., stated that the absolute removal and destruction of bacteria and ordor in occupied spaces such as homes and business buildings may some day be a reality.

He discussed the results of nine years of research in odor and bacteria control principles. Ignorance of these principles has handicapped progress to such an extent that there have been no methods by which the merits of air sanitizing agents can be factually evaluated.

Mr. Kuehner was concerned with the removal of bacteria and odor rather than the masking or neutralizing of odors. The control of such odors as burning tobacco and cooking is possible. Basic techniques for bacteria and odor removal were covered.

The dilution-threshold method provides a means for evaluating odor results in a practical plant. By the establishment of odor loads, desirable odor levels, and odor removal efficiencies, the requirements of a deodorant are clarified and means for satisfying these requirements are given.

There is a consistent difference between inside and outside air, and by comparative measurements of inside and outside air counts, the degree of effectiveness of any mechanism for reducing bacterial levels can be determined.

Heat Transmitted by Chimneys

W. S. Harris, research professor of mechanical engineering, University of Illinois, presented a paper that he had prepared with R. J. Martin, associate professor of mechanical engineering, on Heat Transmitted to the I-B-R Research House from the Inside Chimney. They reported that an inside chimney may supply from 11 to 30% of the normal heat requirements of the rooms to which sides of the chimney are exposed.

While the amount of fuel required to heat a house is affected by the amount of heat supplied to the house by an inside chimney, the chimney heat is not necessarily supplied to all rooms of the house in proportion to the heat requirements of those rooms. Therefore, the heat supplied by the chimney affects both the utilization of fuel and the distribution of heat within the house. A procedure was given for correcting the calculated heat requirements of rooms so as to compensate for the heat derived from an inside chimney.

Friction Losses in Aluminum Ducts

Limited tests conducted by F. W. Hutchinson, professor of mechanical engineering, University of California, confirmed the roughness factor currently used for galvanized ducts. Similar tests were made on round aluminum ducts and the results reported in a paper on Friction Losses in Round Aluminum Ducts. Aluminum ducts of standard construction present less frictional resistance than does the conventional galvanized sheet metal ducts. The advantage of aluminum is said to increase with velocity and at high velocities the size of an aluminum duct for fixed volume of air handled, would be substantially less than the required size of a galvanized iron duct.

Adequate data are not available for determining the possible increase of absolute roughness with diameter, but certain theoretical considerations suggest that a slight increase may be expected.

With round ducts and slip joints, the roughness responsible for loss of head is (1) roughness of the material of which the duct is constructed, and (2) roughness due to discontinuities of the internal surface at each joint. These two types of roughness superimpose and combine to establish the experimentally determined absolute roughness.

The roughness of the material would be expected to remain constant, but the joint roughness might well vary as a function of the diameter.

Year-Round Home Air Conditioner

A paper on Room Air Distribution Research for Year-round Air Conditioning was prepared by S. F. Gilman, research assistant professor of mechanical engineering, University of Illinois; H. E. Straub, research associate in mechanical engineering at the university; A. E. Hershey, advisory engineer, research laboratories, Westinghouse Electric Corp.; and R. B. Engdahl, supervisor, Battelle Memorial Institute.

Although engineering methods have been developed for designing winter heating systems and summer cooling systems for residences, the combining of the cooling and heating operations into a year-round air conditioning system presents several problems. The rapidly accelerating rate at which year-round air conditioning is being installed in residences emphasizes the need for air distribution research.

(*Continued on page* 144)

Flow and Fan—

Principles of Moving Air through Ducts

C. HAROLD BERRY

Gordon McKay Professor of Mechanical Engineering, Harvard University

Part 3. Losses in Straight Uniform Ducts

In this third installment of a twelve-part series, loss calculations in straight, uniform ducts are taken up in detail.

WE have already indicated sketchily what to do with losses when we know them; the present purpose is to indicate how they may be found.

Losses are divided (at least verbally) into two categories: friction losses and shock losses. Friction losses are pictured as resulting from the rubbing of gas along confining walls. Shock losses are pictured as resulting from one stream impinging upon another or upon a wall, as, for example, in abrupt expansion, or in a tee connection through which one stream enters another laterally, or in a fan if the entering air is picked up by a moving blade and forced to change its direction abruptly. Shock loss is due to the dissipation of energy in the violent stirring of the fluid, or, in more technical terms, in eddies appearing at an interface between fluids having unequal velocities. Friction loss near confining walls may actually be of somewhat the same nature, since the fluid next to the wall is moving slowly, and that further away is moving more rapidly. So the distinction between friction and shock may not be as general as it appears. We probably need not argue the question.

In general, in the region of turbulent flow, all losses vary as the square of the velocity, or, what is the same thing, as the square of the rate of flow, Q, in cfm.

In the laminar region, that is, for slow streamline flow, the losses vary as the first power of the velocity, or directly as the rate of flow, Q, in cfm.

In the field of air flow through ducts, as has been mentioned, we virtually always have turbulent flow, and therefore the following discussion of losses will be confined to this region. The few cases in which laminar flow prevails we shall treat as special cases when they arise.

A Word of Warning

Among ventilation engineers who specialize in exhaust systems, such as those used for the removal of objectionable fumes, dusts, etc., there is a general custom of omitting the minus sign affecting the static pressure (gage pressure). Such men of course know that the static pressure in an exhaust system is always below atmospheric pressure, and that the total pressure is higher (in the absolute sense) than the static pressure by the amount of the velocity pressure. However, in this special field, total pressure is not often considered; all computations are habitually based on static pressures. This custom is likely to be puzzling to the beginner, but it must be faced, because it is a common custom. All that can be done is to give notice that it is commonly done, and warn the novice to be on the alert to avoid error.

Velocity Pressure as the Loss Unit

We have remarked that for flow in the turbulent region, all losses are proportional to the square of the velocity of the fluid. This makes it convenient to express all losses as multiples of the velocity head or the velocity pressure. The practice is widespread. A given loss may be stated as half a velocity pressure, or three velocity pressures, or the like. Note particularly that this implies nothing whatever about a change in velocity. One has a feeling that if the fluid has lost three velocity pressures, it has lost more than it had, but this is not the case at all.

For example, consider a flow through a straight duct. At point 1, $h_t = 5$ inches of water, $h_v = 0.8$ inch, and of course $h_s = 4.2$ inches. At point 2, downstream, $h_t = 2.6$ inches, $h_v = 0.8$ inch (unchanged because the duct is straight, the same quantity is flowing, and hence the velocity must be the same), and $h_s = 1.8$ inches. The loss is the drop in total pressure, which is $5 - 2.6 = 2.4$ inches of water, which is three times the velocity pressure, 0.8 inch. The velocity pressure has not been lost at all, but the total loss has been three times the velocity pressure.

If the duct were smaller at the downstream end, the velocity and the velocity pressure would be increased, but there would be a friction loss which would still be expressible in terms of one of these velocity pressures. Which one? Either one, but we must be careful, of course, to indicate which one. For example, consider the loss due to abrupt expansion, which we have already formulated.

$$\left(\frac{V_1 - V_2}{4000}\right)^2 = \left(\frac{V_1}{4000}\right)^2 \left(1 - \frac{V_2}{V_1}\right)^2 = h_{v1}\left(1 - r\right)^2 \quad (64)$$

$$= \left(\frac{V_2}{4000}\right)^2 \left(\frac{V_1}{V_2} - 1\right)^2 = h_{v2}\left(\frac{1}{r} - 1\right)^2 \quad (65)$$

where the new symbol r denotes the ratio of velocities, little over big, which is equal to the ratio of areas, little over big. If the big area is twice the little one, $r = \frac{1}{2}$, and the loss becomes

$$h_{v1}\left(1 - \frac{1}{2}\right)^2 = \frac{1}{4} h_{v1} \quad (66)$$

$$= h_{v2}\,(2 - 1) = h_{v2} \quad (67)$$

For an abrupt expansion of area ratio $\frac{1}{2}$, the loss is $\frac{1}{4}$ of the large (upstream) velocity pressure, and is the same as the small (downstream) velocity pressure.

The same situation applies to the expression of all sorts of losses as multiples of velocity pressure. The

velocity pressure may increase or decrease or remain constant, but this has nothing to do with friction or shock losses, because velocity at any point is determined by the duct area at that point, and the rate of fluid flow, in cfm. Some one velocity pressure may be taken as the basis of computing, and all losses may be expressed in terms of it as the unit.

Another way of handling the situation is to note that, at every point in the system, the velocity is proportional to the rate of flow, Q, cfm. Accordingly, all losses may be expressed in terms of Q^2, the square of the rate of flow. When the duct area changes from place to place, this is preferable, because the flow rate, Q, remains constant, and involves no ambiguity, whereas if we use velocity pressure as the basis, we have constantly to remember which velocity pressure we are using. Errors may result if we slip.

For example, for the abrupt expansion,

$$\left(\frac{V_1-V_2}{4000}\right)^2 = \left(\frac{Q}{4000}\right)^2 \left(\frac{1}{A_1} - \frac{1}{A_2}\right)^2 \quad (68)$$

Since we have remarked that the flow rate, Q, is constant, it is obvious that we are thinking of a single duct without branches. In the study of a branched system, each branch must be computed separately, with the actual flow rate prevailing through that branch.

Loss in a Straight Duct

Consider a body of fluid occupying a length L of a duct as in Fig. 13. There is a drop in static pressure caused by friction at the duct walls, from h_{s1} to h_{s2}. That is, the total force pushing the upstream end of this

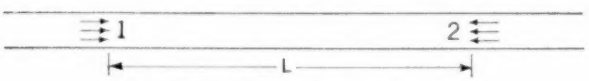


Fig. 13. Section of straight duct.

body of fluid will be greater than the total force opposing the advance of the downstream end. The net force acting must therefore be the difference between these two, namely, the pressure difference multiplied by the duct area

$$\text{Net force, directed downstream} = (h_{s1} - h_{s2})\ A \quad (69)$$

This force must be balanced by the friction at the wall. It seems reasonable to suppose that each square inch of wall surface is contributing the same frictional resistance as each other square inch, that is, that the total friction resistance will be proportional to the wall surface with which the body of fluid is in contact. The surface equals the product of the perimeter of the duct, P, multiplied by the length, L. The actual friction per unit of wall surface depends upon the square of the velocity, the density of the fluid, and a coefficient, c, whose value depends upon the roughness of the wall surface.

$$\text{Total friction force resisting motion} = c\ P\ L\ \rho\ \frac{V^2}{2g} \quad (70)$$

Since the body of fluid is moving with uniform velocity, the force arising from the pressure difference must equal the force arising from friction, whereupon the drop in static pressure per unit length of duct is

$$\frac{h_{s1} - h_{s2}}{L} = c\ \frac{P}{A}\ \frac{\rho V^2}{2g} = c\ \frac{P}{A}\ h_v \quad (71)$$

Hydraulic Mean Radius

We have formulated the friction in a duct in terms of perimeter and area. It is convenient to modify this by defining the hydraulic mean radius as the ratio of area to perimeter.

$$\text{Hydraulic mean radius} = \frac{\text{Area}}{\text{Perimeter}} \quad (72)$$

Let us compute this for a circular duct. Area $= \pi\ r^2$ and perimeter $= 2\pi\ r$, so that the hydraulic mean radius $= r/2 = D/4$, half the geometrical radius, one quarter of the diameter.

Let us compute it for a duct of rectangular cross-section, a units wide, b units high. Area $= ab$ and perimeter $= 2(a+b)$, and hydraulic mean radius $= ab/2(a+b)$.

Substituting these values in the formulation for friction,

$$\frac{h_{s1} - h_{s2}}{L} = c\ \frac{4}{D}\ h_v = c\ \frac{2(a+b)}{ab}\ h_v \quad (73)$$

for the circular and rectangular duct, respectively.

And finally let us modify this to a form that is common, although not universal. Since circular ducts and pipes are widely used, many engineers prefer to simplify the foregoing equation by combining the factor 4 with the coefficient c which gives $f = 4c$ and

$$\frac{h_{s1} - h_{s2}}{L} = \frac{f\ h_v}{D} = f\ \frac{(a+b)}{2ab}\ h_v \quad (74)$$

Here we confront a danger. The friction coefficients in these two forms of the friction equation are not the same; one is four times the other. Accordingly, if we use the equations in this form and undertake to look up coefficients in the literature, we must make sure that we use the appropriate combination of equation and coefficient. In ventilation work, we usually use charts that involve no ambiguity.

Any consistent system of units may be used. In the English system, the natural unit for the friction loss in the first of equations (71) is the pound per square foot. In the second equation (71) and in equations (73) and (74) the unit of friction loss is the same as the unit in which velocity pressure is expressed, which will usually be inches of water. The other factors in the equations are the ratio of dimensions and the friction coefficient, both of which are dimensionless.

We often write equations in terms of V^2, especially for purposes of studying relationships algebraically (this will be done several times in the following discussion), and in such cases we shall assume that if such equations are used for computations, units will be adjusted as required, by introducing the familiar factors 3600, 5.19, and the like, as discussed in Part 2.

Value of the Friction Coefficient

The coefficient f (or c) depends upon the roughness of the duct-wall surface, and also upon the nature of the fluid flow, specifically upon the value of the Reynolds number. In general, there are two modes of variation.

For large values of Reynolds number, that is, for flow well out in the turbulent region, the influence of Reynolds number is relatively less pronounced; surface roughness has a relatively large influence. This is the field in which we usually find ourselves in studying gas flow.

In this region, if it is necessary to guess a value for f (not for c), take 0.02 or 0.025 for ordinary commercial sheet metal ducts.

For intermediate values of the Reynolds number, that is, in the neighborhood of 2000, the friction coefficient varies depending upon whether the flow chances to be laminar or turbulent; there is some uncertainty. Since we shall not often find flows within this region, discussion here would be pointless. If one is engaged in studies requiring information in this field, he will presumably have gone far beyond the scope of this discussion, and will know what to do.

For low values of the Reynolds number, that is, in the region of laminar flow, the friction coefficient f (not c) becomes 64 divided by the value of the Reynolds number. Thus, in the laminar region, the friction drop becomes

$$\frac{h_{s1} - h_{s2}}{L} = \frac{64}{N_R}\,\frac{h_v}{D} = \frac{64}{N_R}\cdot\frac{(a+b)}{2ab}\,h_v \qquad (75)$$

Since the Reynolds number has the velocity V as a factor, and since the velocity pressure, H_v, has V^2 as a factor, it will be seen that this equation agrees with our earlier statement that in the laminar region the friction drop depends upon the first power of the velocity. For practical purposes, in the field of gas flow, it is usually expressed in simpler form in terms of velocity.

Friction Loss and Total Pressure

We have earlier stated emphatically that loss must be thought of as a drop in total pressure, since static pressure varies not only because of losses but also through changes of velocity and velocity pressure. But in the discussion of friction drop in a straight duct, we have expressed all of the losses as a drop in static pressure. Obviously this involves no contradiction, since in a straight duct the velocity pressure is constant, and a drop in total pressure entails an equal drop in static pressure. So, for this case, we may use the general notation, h_L, for loss of pressure and note that

$$h_{L\,1\,2} = h_{s1} - h_{s2} = h_{t1} - h_{t2} \qquad (76)$$

Charts

For practical work, charts are convenient. It is customary to plot such charts for a duct of circular cross section. We shall presently see how to handle rectangular ducts. It is also customary, in the ventilation field, to plot such charts for air of standard density (0.075 lb/cu ft). If a gas of significantly different density is to be handled, the loss should be multiplied by the density ratio, since loss measured in inches of water is proportional to the density of the flowing fluid.

In plotting a chart for air flowing through a circular duct, there are four related items that interest us:

(1) friction drop, inches of water, per 100 feet of duct length
(2) quantity of air flowing, cfm
(3) duct diameter, feet
(4) air velocity, fpm.

As coordinates, it is common to use the friction drop and the quantity flowing, and logarithmic scales are used to simplify the chart. One family of lines is drawn for various values of velocity, another family for various diameters. Any two items enable us to locate a point in the chart, from which the two unknown items can be read off directly, as in Fig. 14, which is from Design of Industrial Exhaust Systems, by John L. Alden, 1948 edition.

These charts commonly include the variation of the friction coefficient f with diameter and velocity (Reynolds number). Some of them also embody an exponent differing from 2 as applied to the velocity and from 2 and 5 as applied to quantity and diameter (see equation 78), giving results agreeing somewhat more closely with experimental results found by the authors of such charts. Again we remark that this discussion is not intended to present the full details of a complete analysis of high precision.

Velocity and Quantity

If we rewrite equation (74) using the symbol h_L for the loss due to friction and express the velocity pressure as in equation (39), we have an equation that relates the loss to the velocity, for a duct of circular cross-section.

$$h_L = f\,\frac{L}{D}\,\rho\left(\frac{V}{1096.5}\right)^2 \qquad (77)$$

But, from continuity, $V = Q/A$ and the area of a round duct is $(\pi/4)D^2$ so that $V = (4/\pi)Q/D^2$. If we substitute this value of V in equation (77) we have

$$h_L = f\,\frac{L\ \rho\ Q^2}{D^5} \times \frac{1}{741{,}700.} \qquad (78)$$

where h_L is in inches of water with L and D in feet, ρ in pounds per cubic foot, and Q in cubic feet per minute.

Equations (77) and (78) enable us to study the manner in which the friction loss varies with circumstances.

The items that can vary are the diameter and length of the duct (we restrict ourselves to a circular duct), the density of the gas, the gas velocity, and the gas volume per unit time.

Of course the roughness of the interior surface of the duct will vary from duct to duct, but we can say little about this in general, save that it is reflected in the value of the coefficient f, which may vary widely. For air flowing through well-made ducts of smooth galvanized steel sheet, a fair average value of f is about 0.02, or a little less. The value of f varies also with the Reynolds number. For ordinary work, we use a chart, rather than the equation, and this has the advantage that the variation of f with the Reynolds number is included. Some charts, at least, are plotted with variable f rather than a single constant value. For more elaborate analysis, we must refer to the literature, which presents a considerable mass of data.

The present discussion is intended to apply to cases in which a reasonable approximation suffices, and at the moment we are concerned with the influence of variations in duct dimensions, gas density, velocity, and quantity.

(1) A duct of given diameter, D, carries a given

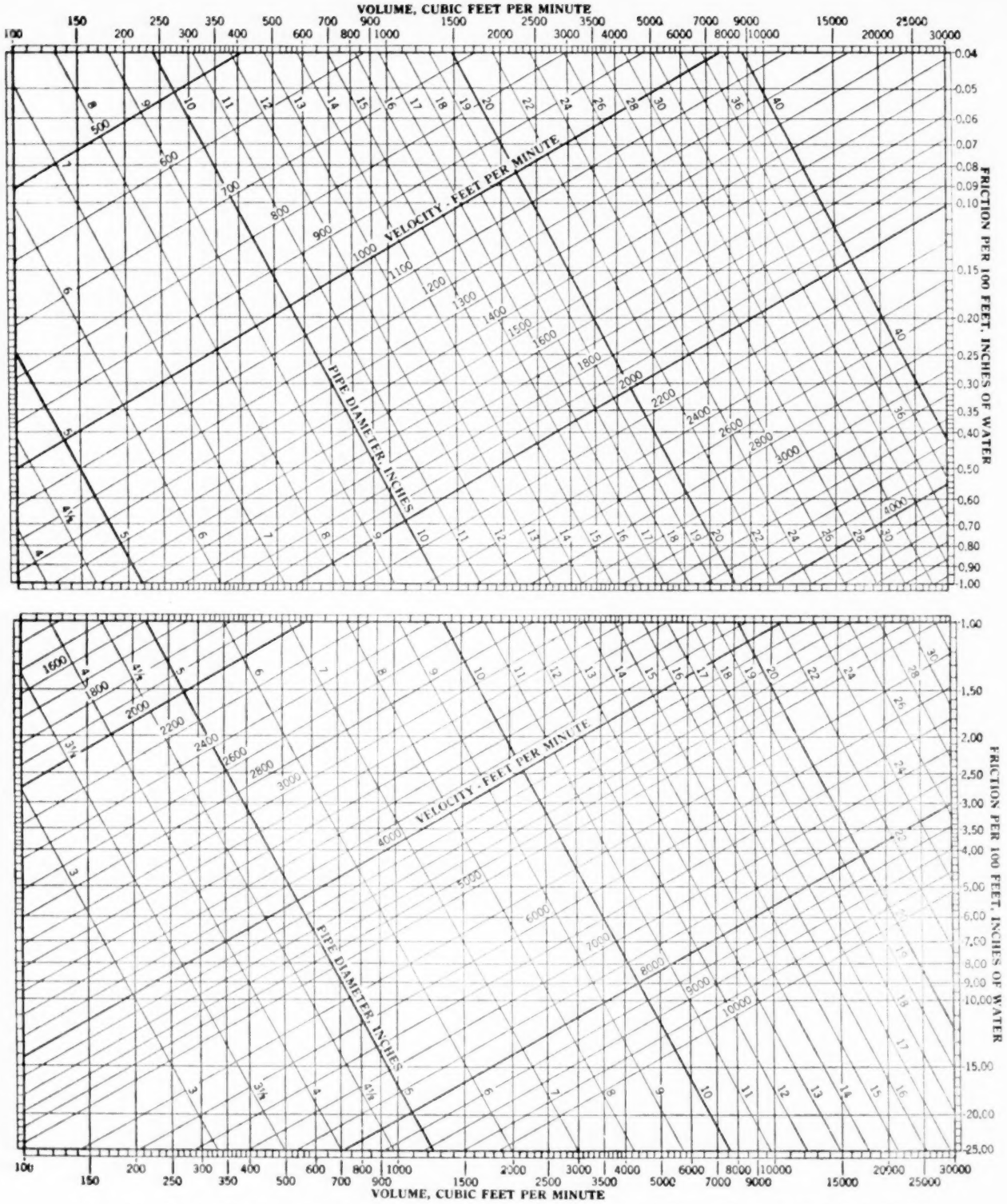

VOLUME, CUBIC FEET PER MINUTE
VELOCITY - FEET PER MINUTE
PIPE DIAMETER, INCHES
FRICTION PER 100 FEET, INCHES OF WATER
VOLUME, CUBIC FEET PER MINUTE

Fig. 14. Friction loss in round pipes and ducts, from Design of Industrial Exhaust Systems, by John L. Alden.

quantity, Q, and hence has a given velocity, V. The friction loss is proportional to the length of the duct.

(2) A given duct carries a given quantity, Q, first of one gas, and second of another gas of different density. The friction loss is proportional to the density of the gas. Lighter gas (hydrogen or hot air), smaller loss—— heavier gas (carbon dioxide or cold air), larger loss.

(3) A given duct carries various quantities of the same gas, and hence has various velocities. The loss is proportional to the square of the quantity, or the square of the velocity, Q^2 or V^2. If we double the rate of flow, we multiply the loss by 4; if we halve the rate of flow, we divide the loss by 4.

(4) Now consider two ducts of the same length, but different diameter, with flow at the *same velocity* through both of them. Equation (77) tells us that the larger duct

has smaller loss, in the inverse ratio of the diameters. A duct of double diameter has half the loss, but notice well, this is for the *same velocity*. Accordingly, the duct of double diameter, having four-fold area, will carry four times as much gas as the smaller duct. Half the loss for delivering four times the volume. Obviously, this is not a very good comparison. It does not help much to be told that we can reduce the friction loss of a system by making it twice as big and delivering four times as much air.

(5) A more useful comparison is between two ducts of the same length and different diameters each handling the *same quantity* of gas. Equation (78) tells us that the loss varies inversely as the fifth power of the diameter. If we put the same volume of gas through a duct of twice the diameter, the loss will be divided by 32. But the duct of double diameter has fourfold area so that, with the same volume flowing, the velocity will be reduced to one quarter of the value in the smaller duct. This is a more sensible comparison, for usually we are required to deliver a stated volume of air (or other gas), and the duct size is often relatively unrestricted. We have then to study the cost of power required to overcome the friction, and the cost of the duct. The larger duct has smaller friction, but costs more and is heavier and bulkier. We must find a duct size that gives a good compromise. In some cases (notably in the transport of material by an air stream) we are limited by the minimum velocity that will carry the material, and this sets an upper limit on the duct diameter.

For ready comparison of friction drops, it is convenient to have a table or curve showing the fifth powers of numbers representing the duct diameter.

The following table gives values of the fifth power of the ratio of duct diameters, which will be the ratio of the friction loss, the larger loss appearing in the smaller duct. This relation is for two ducts carrying the *same quantity*, Q, *cfm* of the *same gas*.

TABLE 1—FIFTH POWERS OF NUMBERS FROM 1.00 to 1.59

	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
1.0	1.000	1.051	1.104	1.159	1.217	1.276	1.338	1.403	1.469	1.539
1.1	1.611	1.685	1.764	1.842	1.925	2.011	2.100	2.192	2.288	2.386
1.2	2.488	2.594	2.703	2.815	2.932	3.052	3.176	3.304	3.436	3.572
1.3	3.713	3.858	4.007	4.162	4.320	4.484	4.653	4.826	5.005	5.189
1.4	5.378	5.573	5.774	5.980	6.192	6.410	6.634	6.864	7.101	7.344
1.5	7.594	7.850	8.114	8.384	8.662	8.947	9.239	9.539	9.847	10.162

This table gives more significant digits than should be used in practice, since neither the making nor the measuring of ducts give the diameters to this order of accuracy. The extra digits are included to facilitate interpolation between values. For instance, the value for the ratio 1.134 is 0.4 of the way between 1.842 and 1.925, which is 1.875 (the difference is 0.083, four-tenths of this is 0.33, which, added to 1.842, gives 1.875). We should probably call this 1.88 or perhaps more sensibly, 1.9.

The table could of course be extended indefinitely; it covers the usual range of ratios; others can be computed if needed.

For example, compare the friction in two ducts of 8 and 10 inch diameter. The ratio is $10/8 = 1.25$. The fifth power of 1.25 is 3.052; the friction in the 8-inch duct will be a bit over three times the friction in the 10-inch duct, carrying the same quantity of the same gas.

The curve presented in Fig. 15 may be easier to use than Table 1.

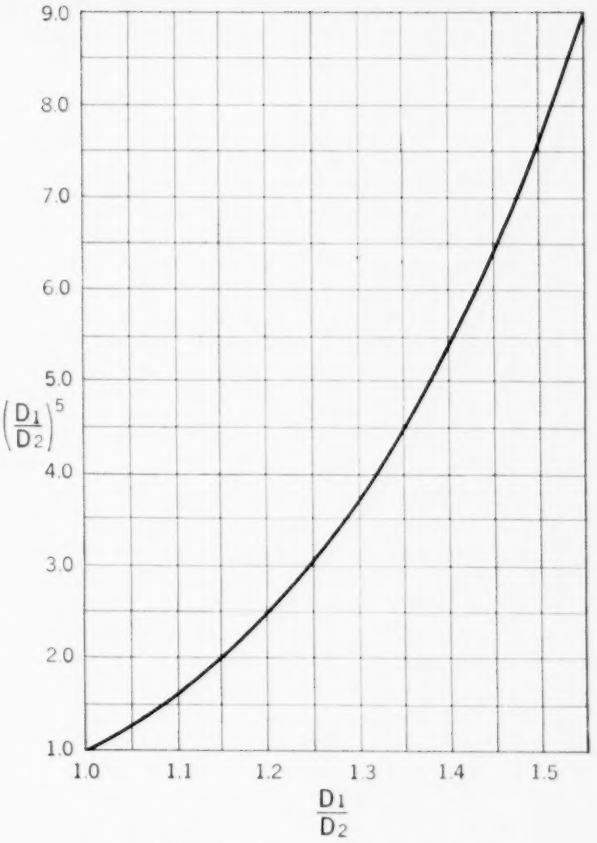


Fig. 15. Fifth powers of diameter ratios.

The table or curve are used in the design of branched duct systems. In order to balance the friction drop through various branches, it is often necessary to substitute for the duct size first assumed a duct of smaller (rarely larger) diameter, carrying the same quantity. The drop for the given duct having been computed already, it is easy to adjust to that for a smaller duct by means of the fifth power of the diameter ratio. This computation will usually be applied only to two consecutive duct sizes (differing by one inch or, sometimes, by one-half inch). For much larger differences of duct diameter, this method should not be used, since there may be too great a change in the Reynolds number, and hence a significant change in the friction coefficient. For large diameter differences, it is safer to consult a friction loss chart.

Friction Loss in Rectangular Ducts

It is most convenient to find the friction loss in a duct of rectangular cross-section by finding the diameter of a duct of circular cross-section having the same friction loss as the rectangular duct. Then our charts or tables giving the loss for circular ducts will serve.

Throughout this discussion we shall use the subscript c for a circular duct, and the subscript s for a square-cornered rectangular duct. The diameter of the circular duct will be D as heretofore, and the dimensions of the rectangular duct will be a by b. Units may be feet, inches, or any other units, so long as the same unit is used for D, a, and b.

The hydraulic mean radius of a duct is its cross-sectional area divided by its perimeter. For a circular duct it is D/4, and for a rectangular duct it is

$$\frac{ab}{2(a+b)}$$

As was remarked, the friction loss in a duct depends upon its hydraulic mean radius. A circular duct and a rectangular duct having the same hydraulic mean radius will have the same friction loss per unit of length, provided that the coefficient f, the density ρ, and the velocity V are the same in both ducts. As will presently appear, the quantity Q will not be the same.

For the circular duct and the rectangular duct, equality of hydraulic mean radius gives

$$\frac{D}{4} = \frac{ab}{2(a+b)} \text{ or, more simply, } D = \frac{2ab}{a+b} \qquad (79)$$

A circular duct of diameter as given by these equations will have the same friction drop per unit of length, if f, ρ, and V are the same in both. So, with the dimensions of the rectangular duct, we compute the diameter of the equivalent circular duct, and look up the friction loss in tables or charts for circular ducts. This will be the same as the friction loss in the given rectangular duct, for flow of the same gas at the same *velocity*. Obviously it is also assumed that the interior surfaces are alike, so that the coefficient f is the same for both ducts.

It may be interesting to examine further this expression for the diameter of the equivalent circular duct.

$$D = \frac{2ab}{a+b} = 2a\left[\frac{1}{\frac{a}{b}+1}\right] \qquad (80)$$

If a = b, that is, if the rectangular duct is square, D = a. A square duct one foot square has the same friction loss as a circular duct one foot in diameter.

If b is larger than a, the fraction a/b will be less than unity, so that the fraction in the brackets will be larger than one half, and as b increases indefinitely, the ratio a/b grows smaller, approaching zero, whereupon the bracketted fraction approaches unity. Accordingly, D approaches the value $2a$. For a rectangular duct of flat cross-section, the diameter of the equivalent circular duct (for the same *velocity* of flow) approaches twice the short dimension of the flat duct.

How about the quantity flowing through these equivalent ducts? The velocity is the same in both of them. The area of the circular duct is $(\pi/4)\ D^2$ and the area of the rectangular duct is ab, hence

$$Q_c = V\ \frac{\pi}{4}\left(\frac{2ab}{a+b}\right)^2 \text{ and } Q_s = V\ a\ b \qquad (81)$$

since in every duct, from the equation of continuity, Q = V A.

Then the ratio of quantities will be

$$\frac{Q_c}{Q_s} = \frac{\frac{\pi}{4}\left(\frac{2ab}{a+b}\right)^2}{ab} = \frac{\pi}{4}\,\frac{4\ ab}{(a+b)^2} = \frac{\pi\ ab}{(a+b)^2} \qquad (82)$$

Let us see how the value of this ratio turns out. We shall write out the square of the denominator and divide through by ab.

$$\frac{Q_c}{Q_s} = \frac{\pi\ ab}{a^2 + 2ab + b^2} = \frac{\pi}{2 + \frac{a}{b} + \frac{b}{a}} \qquad (83)$$

The quantity $\frac{a}{b} + \frac{b}{a}$ is obviously equal to 2 if a = b.

For unequal values of a and b this quantity is always greater than 2. As the values of a and b differ more widely, the value of this expression increases without limit. Accordingly, the denominator of the final member of equations (83) will have the value 4 or more. Therefore the ratio of quantities will be $\pi/4$ or less.

$$\frac{Q_c}{Q_s} \leqq 0.7854 \qquad (84)$$

So the result of this method is that, for a given rectangular duct, carrying a given *quantity* of gas, we find the diameter of an equivalent circular duct which, with the same *velocity*, will have the same friction, but will carry less gas. So, when we look up the friction drop for this equivalent circular duct, we must not use the diameter together with the quantity of air flowing through the rectangular duct. We must compute the velocity in the rectangular duct, and use this velocity together with the computed diameter of the equivalent circular duct, and, referring to charts or tables, find the friction loss in the circular duct, which will be the same as the friction loss in the rectangular duct with gas flowing at the same velocity. The equality of *velocity* is emphasized because errors are often made by using the same *quantity*, which is incorrect.

If our object is merely to find the friction loss in a given rectangular duct, this method is fairly satisfactory, although it does require the computation of velocity, which may not otherwise be needed. But it is easily done, and if our problem always took this form, would hardly justify further consideration.

But sometimes the problem arises in another way. We may wish to make an actual physical substitution of a circular duct for a rectangular duct, or vice versa, and in this case we shall naturally wish the two ducts to carry the same *quantity* of gas, with the same friction loss per unit length.

Since the circular duct having the same friction loss for the same velocity carries less air, it seems obvious that for a circular duct which carries the same quantity we must increase the diameter of the circular duct. But this increase must be made with no change in the friction loss. Equation (78) tells us that two circular ducts of different diameter will have the same friction drop if the value of Q^2/D^5 is the same. Accordingly, we wish to increase the diameter of the circular duct to make the value of Q_c equal to Q_s, and at the same time hold the same value for the ratio of Q^2 to D^5. That is, we wish to satisfy two equations:

$$\frac{Q_c}{Q_s} = \frac{\pi\ ab}{(a+b)^2} \text{ and } \left(\frac{Q_c}{Q_s}\right)^2 = \left(\frac{D_v}{D_q}\right)^5 \qquad (85)$$

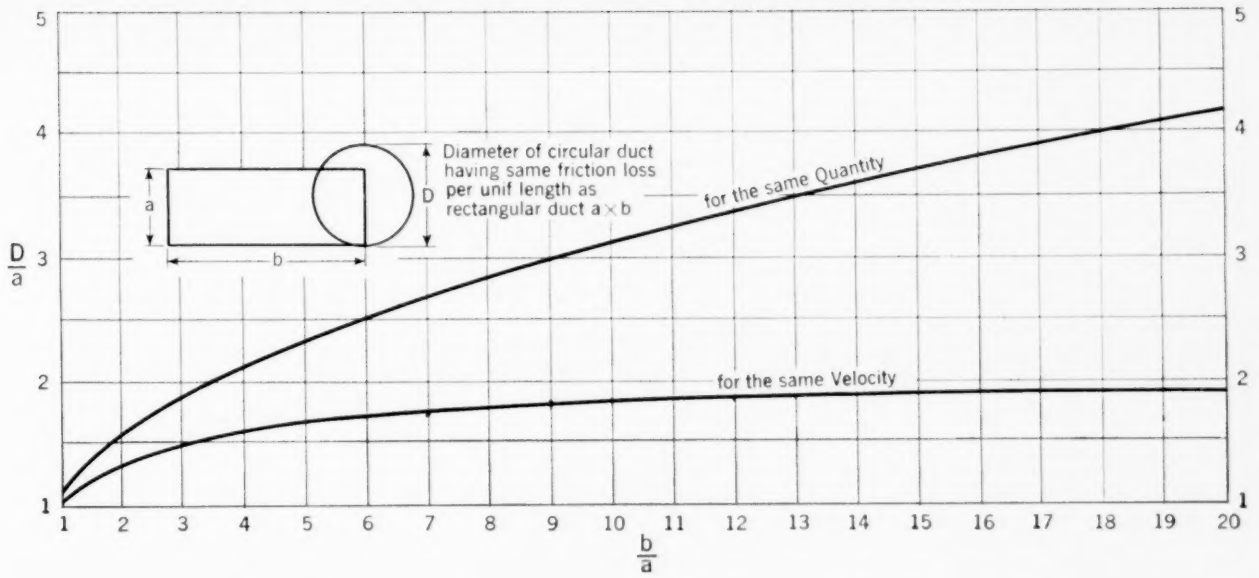


Fig. 16. Frictional equivalent, round and rectangular ducts.

where D_q is the diameter of a circular duct having the same friction loss as the rectangular duct when carrying the same quantity Q, and D_v is the diameter of the circular duct having the same friction loss as the rectangular duct when gas is flowing at the same velocity, V.

The result is

$$\frac{D_q}{D_v} = \left[\frac{(a+b)^2}{\pi\ ab}\right]^{2/5} \tag{86}$$

or, what is the same thing,

$$D_q = D_v \left[\frac{(a+b)^2}{\pi\ ab}\right]^{2/5} \tag{87}$$

But we have already seen in equation (79) that

$$D_v = \frac{2ab}{a+b} \tag{88}$$

and combining these equations gives us

$$D_q = \frac{2ab}{a+b}\left[\frac{(a+b)^2}{\pi\ ab}\right]^{2/5} \tag{89}$$

$$D_q = \frac{2}{\pi^{2/5}}\ \frac{(ab)^{3/5}}{(a+b)^{1/5}} \tag{90}$$

This gives the diameter of a circular duct that has the same friction drop per unit length as the rectangular duct, when the two ducts are carrying the same *quantity* of gas.

The area of the circular duct carrying the same quantity is

$$A_q = \frac{\pi}{4} D_q^2 = \frac{\pi}{4}\left[\frac{2}{\pi^{2/5}}\ \frac{(ab)^{3/5}}{(a+b)^{1/5}}\right]^2 \tag{91}$$

and the area of the rectangular duct is

$$A_s = ab \tag{92}$$

Since the quantity flowing is the same in both these ducts, the velocities will be inversely proportional to their areas, so that

$$\frac{V_s}{V_c} = \frac{A_q}{A_s} = \frac{\pi}{4}\ \frac{1}{ab}\left[\frac{2}{\pi^{2/5}}\ \frac{(ab)^{3/5}}{(a+b)^{1/5}}\right]^2 = \frac{\pi^{1/5}\ (ab)^{1/5}}{(a+b)^{2/5}} = \left[\frac{\pi}{2 + \frac{a}{b} + \frac{b}{a}}\right]^{1/5} \tag{93}$$

which is always less than unity.

It will be noted that this velocity ratio equals the 1/5 power of the quantity ratio expressed in equation (83). We noted that the quantity ratio is equal to or less than $\pi/4$. Accordingly, the velocity ratio now under consideration must be equal to or less than $(\pi/4)^{1/5}$, that

TABLE 2—FRICTIONAL EQUIVALENT RECTANGULAR AND CIRCULAR DUCTS

Rect. Duct a = 1	Circular Ducts Same Friction			
	Same Velocity		Same Quantity	
b	D_v	$\frac{Q_s}{Q_c}$	D_q	$\frac{V_s}{V_c}$
1	1.0	.785	1.101	1.050
2	1.333	.698	1.532	1.075
3	1.500	.589	1.854	1.112
4	1.600	.503	2.107	1.148
5	1.667	.436	2.322	1.180
6	1.714	.385	2.512	1.210
7	1.750	.344	2.683	1.238
8	1.778	.310	2.839	1.264
9	1.800	.283	2.983	1.287
10	1.818	.260	3.118	1.310
11	1.833	.240	3.245	1.330
12	1.846	.223	3.364	1.350
13	1.857	.208	3.478	1.368
14	1.867	.200	3.580	1.385
15	1.875	.184	3.690	1.403
16	1.882	.174	3.789	1.419
17	1.889	.165	3.885	1.434
18	1.895	.157	3.977	1.449
19	1.900	.149	4.066	1.463
20	1.905	.143	4.153	1.476

is, equal to or less than 0.9528. For a square duct the velocity ratio will equal 0.9528; as the rectangular duct departs further from square, the velocity ratio will decrease progressively.

The reciprocal of this velocity ratio is more useful. It is V_c/V_s and this has a minimum value of 1.0495 (the reciprocal of 0.9528) for a square duct and increases without limit as the rectangular duct departs further from square. The velocity in the equivalent circular duct (for the same quantity) is always higher than the velocity in the rectangular duct, in a ratio that increases as the rectangular duct departs from square.

Table 2 gives values of several of the items we have been discussing. For the rectangular duct, the short side is taken as unity, and the long side ranges from 1 to 20, which should cover a wider range than is likely to be met in practice. The tabular values may of course be used for any duct; for example, a duct 6 by 42 inches has the proportions 1 by 7, and the diameter of an equivalent circular duct for the same quantity is 2.512 (for a = 1), which is 6 times 2.512 = 15.072, that is, a round duct 15.1 inches in diameter has the same friction drop as a duct 6 by 42 inches, both carrying the same quantity of the same gas.

The curves in Fig. 16 may prove as useful as Table 2.

Friction and shock losses in diverging passages will be the subject of Part 4 to be presented next month.

Heating The Pennsylvania Turnpike Service Buildings

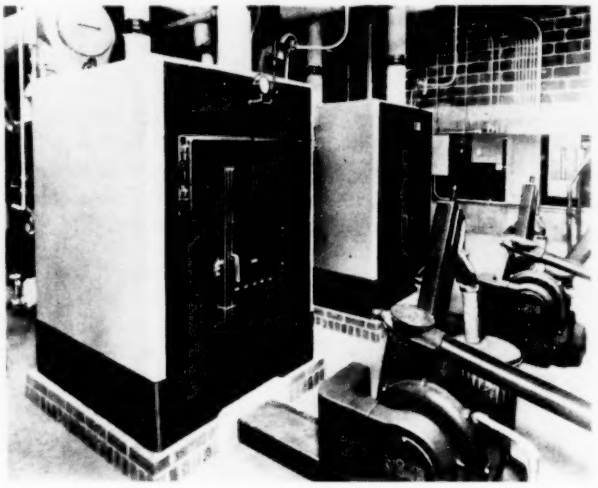
The sprawling Pennsylvania Turnpike System, with its 327 miles of highway, has thousands of square feet of steam-radiation boiler capacity tucked away in its restaurants and utility, toll gate and maintenance buildings, 36 of which contain 15-psi, sectional cast-iron steam boilers manufactured by The National Radiator Co., Johnstown, Pa. Regardless of outside temperature or weather conditions, not only must the working space be kept warm, the maintenance buildings must have enough heat available to thaw cinders by the truck load.

Since winter conditions frequently consist of below-zero temperatures as well as high winds, all of the installations are designed to maintain a temperature of 70F inside with a temperature of minus 10F outside. The individual heating plans are thermostatically controlled with a summer-winter changeover to provide domestic hot water. Condensate is returned to the boilers by combination duplex pumps that serve also as boiler-feed pumps. Temperature control in each building is such that the steam boiler operates at the demand of any thermostat, and continues to run until all the thermostats are satisfied. It then fires up inermittently as required to supply hot water for washrooms.

The heating equipment was selected after careful consideration to suit the particular needs of the installations and to provide for stability, long life and efficient operation. Boilers along one stretch of the turnpike are oil fired and the remainder have anthracite coal stokers. Capacity of the boilers ranges from 900 to 3,500 square feet of steam radiation. To provide for completely automatic operation, they are equipped with the usual pressurestats, aquastats, feedwater regulators, low-water and ignition-failure cut-offs, etc.

The oil fired units have mechanical oil-pressure atomizing burners capable of burning 11 gallons of No. 2 fuel oil per hour. Oil is stored in 2,000-gallon underground tanks. Anthracite fired boilers use bin-feed, under-feed firepot stokers with automatic ash removal. The coal system incorporates bin feed traps to provide easy access for removing foreign particles and excessively large coal particles. The stoker firing capacity is based on anthracite coal with a heat content of 13,000 Btu.

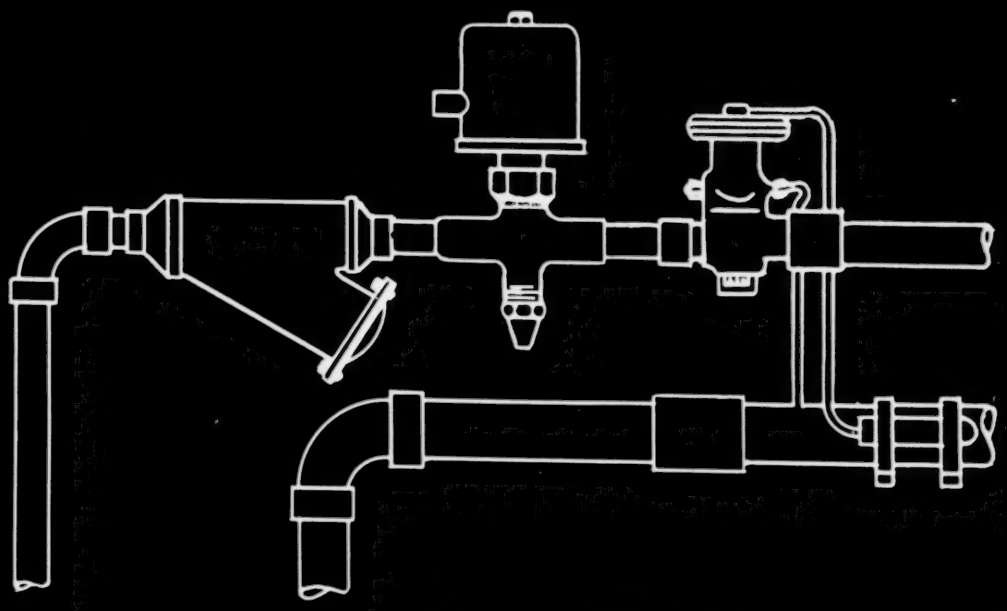
Each National boiler is equipped with a tankless type water heater, which supplies hot water for washrooms and other domestic uses. It has a capacity of 210 gallons



per hour from 40F to 140F with boiler water of 130F. Connected to the boilers below the normal water level, the device maintains uniform domestic water temperature through automatic control, which regulates boiler-water flow through the heater.

Steam for heating the maintenance buildings comes from two boilers installed in the basements of each. The office section has exposed cabinet-type, wall-hung convectors controlled by area thermostats. In the garage and maintenance area, horizontal forced circulation unit heaters are hung from the roof trusses, and the floor areas contain wrought-iron radiant-heating panels. The radiant-heating, supplied with hot water from a steam-hot water converter, capacity of which is 900 gph from 100F to 120F with steam at zero pressure, is regulated to keep the floor temperature between 80 and 85F by a separate thermostat installed in the floor.

Many years experience with this type heating along the original stretch of highway has proven the value of this design to such an extent that it has been incorporated in the recent east and west extensions. J. E. Greiner Co. of Baltimore was architect for the buildings and George & Hartman of Baltimore was heating-systems designer. Heating contractors on the job were: W. L. Ramsey, Harrisburg, Pa., J. J. Betke, Beaver Falls, Pa., and John Galbreath, Pittsburgh, Pa.



Refrigerant Piping for Air Conditioning Systems

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Heating and Ventilating Magazines Reference Section

Refrigerant Piping for Air Conditioning Systems

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Correct design and installation of refrigerant piping are important factors in the satisfactory operation of air conditioning systems. Piping to various parts of a refrigeration installation is described, and illustrations employed to emphasize approved and unapproved practices.

WITH the exception of self-contained or packaged units, refrigerant piping must still be tailored to suit each job. It is important, therefore, that good piping principles are followed to give the user maximum return from the equipment and to protect it from costly failures.

This article discusses these general principles, and demonstrates their application to typical equipment layouts, as used on Freon 12 air conditioning systems.

Basic Principles

It is impossible to give several, or even a hundred rules which would cover all of the problems arising during the design and installation of refrigeration or air conditioning piping. However, there are several basic rules which should always be followed in laying out piping to provide a neat, serviceable installation. Adherence to these rules will also, in most cases, assure good system operation. These basic rules are:

(1) Refrigerant lines should be as short and should run as direct as possible. This will minimize tube and refrigerant requirements and will contribute to proper system performance by reducing pressure drops.

(2) Locate refrigerant piping so that access to system components is not hindered, and so that the piping does not interfere with normal use of building appurtenances, such as doors and windows. All components of a system will require periodic inspection and maintenance, and this work will be simplified if access can be had to equipment without climbing over and under piping, and if such accessories as Freon flow sight glasses can be easily observed.

(3) Avoid locations where copper tube will be exposed to possible injury. If this is not feasible, enclose tube in a protective conduit. Some codes require this.

(4) Use as few joints and fittings as possible, to reduce cost, avoid leak sources, and minimize pressure drop. Fittings should be of the wrought copper long radius type which have better flow characteristics than short radius forged or cast fittings. Wherever possible Y fittings should be used in preference to 90 deg connections.

(5) Use a continuous length of soft copper tube, bent around obstructions, in inaccessible locations, where it would be difficult to install tube with fittings, or where obstructions would require an unusually large number of fittings. Soft tube so used must be properly supported and should never be bent more than 22½ deg without the use of bending tools.

(6) Pitch all horizontal lines a minimum of ¼ inch in 10 ft in the direction of refrigerant flow, and avoid unnecessary traps.

(7) Do not expose piping to external sources of heat, if it can be avoided.

(8) If space will not allow a single large line, use two or more smaller lines in parallel.

Once the equipment locations and approximate line locations have been determined, the next problem facing the designer is to size and detail the suction, discharge and liquid lines. This is the most important part of the job, since an improperly sized or connected line can reduce the efficiency of the overall system, and actually result in compressor failure.

Pipe Sizing

The most important considerations in sizing pipe are (1) friction losses in piping runs and (2) optimum velocities of refrigerant through the piping. In this regard, it must be remembered that oil circulating with Freon does increase pressure drop and that all compressors will pump some oil. Because there is oil circulation, the velocity of the refrigerant must be high enough to carry entrained oil through the system and back to the compressor. Initial piping cost and operating cost are also factors in determining pipe sizes.

While oversizing horizontal or vertical downward lines will have no detrimental effect on system operation, proper sizing of the vertical, or upward sloping risers is extremely important to insure oil return and to eliminate trapping. Generally, these lines should be sized at minimum flow to provide oil return under all operating conditions, and the pressure drop checked at maximum flow to be certain it is not excessive.

The size of the tube adapter supplied on a piece of equipment, compressor, condenser, etc., does not determine the size of the line to be used. Manufacturers select a valve size or connection fitting on the basis of its pressure drop and its application to an average system. There are many cases where line sizes will be greater than the connection size, and some cases where the line size may be smaller. In both cases, reducing fittings must be used.

With these general principles in mind, let us now analyze the specific requirements of each type of refrigerant line, and apply these needs to some of the more commonly encountered situations.

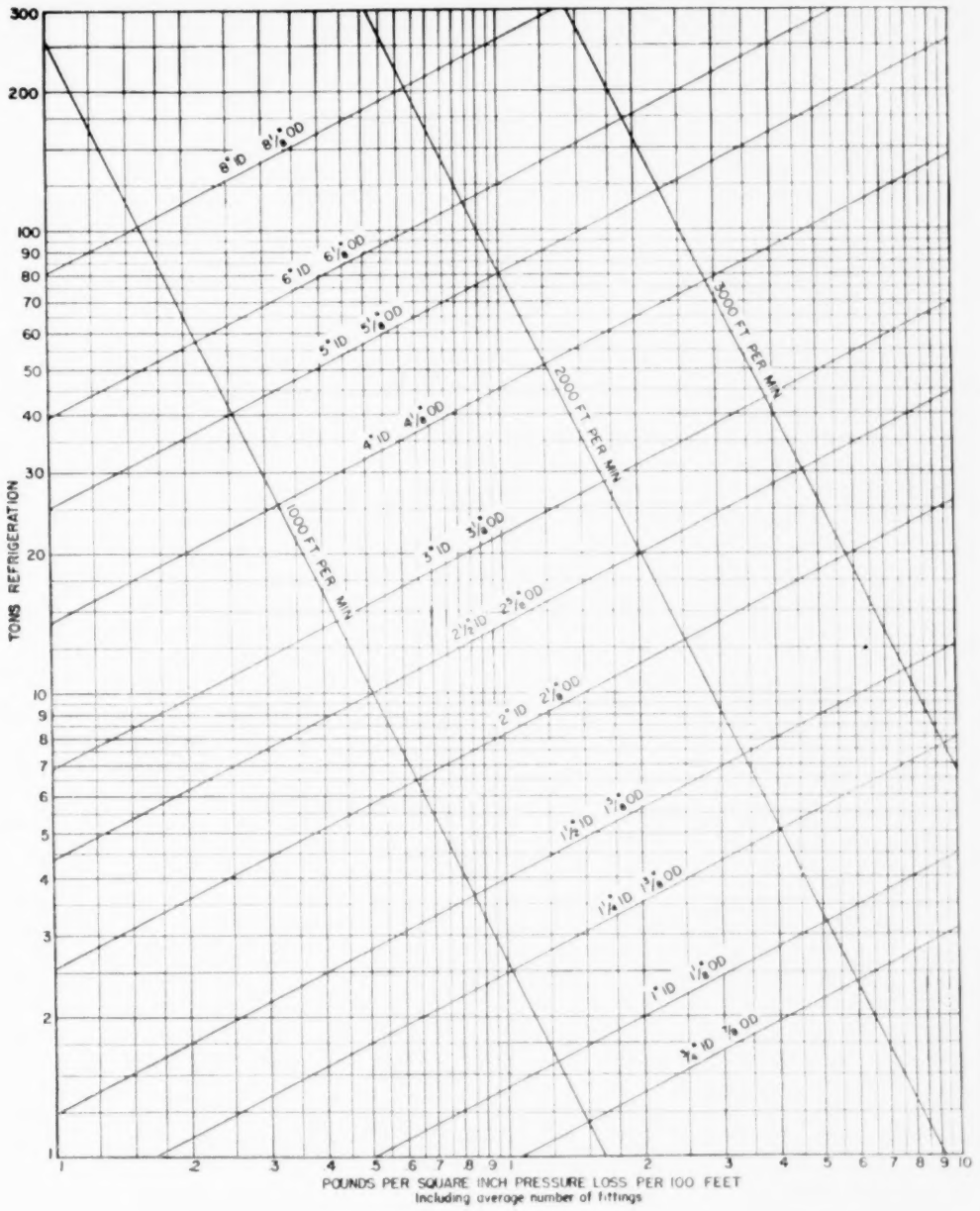

TONS REFRIGERATION
POUNDS PER SQUARE INCH PRESSURE LOSS PER 100 FEET
Including average number of fittings
1000 FT PER MIN
2000 FT PER MIN
3000 FT PER MIN
8" ID 8⅛" OD
6" ID 6⅛" OD
5" ID 5⅛" OD
4" ID 4⅛" OD
3" ID 3⅛" OD
2½" ID 2⅝" OD
2" ID 2⅛" OD
1½" ID 1⅝" OD
1¼" ID 1⅜" OD
1" ID 1⅛" OD
⅞" ID 1⅛" OD

Fig. 1. Suction line Freon vapor pressure drop, based on conditions at 37 psi suction pressure. Recommended velocity, 1,200 to 3,000 fpm; recommended pressure loss in system suction lines, 2 to 3 psi.

Suction Lines

Let us consider suction line problems first because they are the most important insofar as compressor life and system performance are concerned, and also because they are the most difficult. The primary function of the suction line is to return Freon gas and lubricating oil from the evaporator to the compressor, without creating or allowing the return of oil slugs or Freon slugs which might damage the compressor.

With a suction line velocity below 1,200 fpm in a vertical riser, oil will probably not be returned; consequently this is the minimum design value. In horizontal lines which are pitched toward the compressor, velocities as low as 750 fpm may be safely employed. Maximum suction line velocity may be considered as approximately 3,000 fpm, since in higher ranges noise becomes excessive.

Total pressure loss in suction piping, including all valves and fittings, should not exceed 2 to 3 psig. Pressure loss in the suction line is extremely detrimental to system efficiency since the capacity of a compressor drops rapidly with suction pressure. For this reason, suction line losses are preferably held to the pressure equivalent of a 2F change in saturated refrigerant temperature. Thus, for an air conditioning system with a refrigerant evaporating temperature of 40F, we would have an allowable pressure drop of 1.3 psig, while a cold storage system with a 10F evaporating temperature would have an allowable drop of only 1.17 psig. Since the layout of a system may require high velocities in a riser to insure oil return, it is very often necessary to oversize horizontal lines to keep the total pressure drop within limits.

Line sizes may be selected from standard pressure drop tables, or from data put out in various forms by equipment manufacturers. Figure 1 presents selection data in an easily used graph form, for use with Freon 12 air

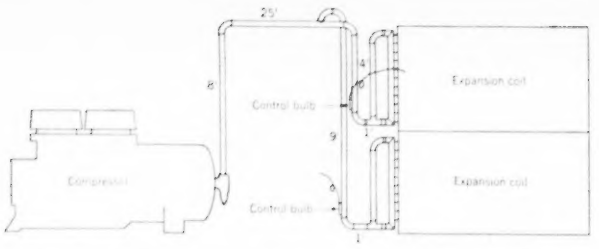


Fig. 2. Suction connections to two D. E. coils for capacity reduction.

conditioning systems with evaporating temperatures in the range of 40F. Pressure drops are shown per 100 ft of pipe, including an average number of fittings, and are based on a normal amount of oil circulating with the Freon. Some pressure drop data does not include the effects of oil circulation, and therefore will give lower drops. As an example of the use of this chart, let us assume a typical system, as shown in Fig. 2, wherein load calculations have resulted in the selection of a 20-ton compressor with 50% capacity reduction and two equally sized and loaded direct expansion coils. For 50% capacity operation, the top coil will be shut off by means of a solenoid valve in its liquid line, thereby maintaining a relatively constant suction pressure in the system. Space considerations have dictated the equipment location and result in 33 ft of suction line carrying a maximum of 20 tons and two parallel paths of 10 ft and 5 ft carrying a maximum of 10 tons each. The piping shown would be considered to have an average number of fittings. Control settings will be such that minimum system load will be 15 tons on both coils; 7½ tons on one coil.

The first requirement is that the velocity in the suction risers be 1,200 fpm or higher. Since the minimum load to be handled in each riser is 7½ tons we enter the chart horizontally on the 7½ ton line and find that the first tube size in the 1,200 to 3,000 fpm range is 1⅝-inch O.D., with an actual velocity of approximately 2,000 fpm. Dropping down from this point we find we will have a pressure drop of 3.5 psig per 100 ft of run. For the lower coil, with 10 ft of suction riser, section *A* of Fig. 2, this 1⅝-inch O.D. line will have a pressure drop at minimum load of 0.35 psig. To determine conditions at the maximum coil load of 10 tons, we locate the intersection of the 10-ton horizontal line and the 1⅝-inch O.D. slanting line. This point lies between the 2,000 and 3,000 fpm velocity lines, at approximately 2,600 fpm which is not too high. Dropping down from this point, we find that pressure drop at maximum load is 6.25 psig per 100 ft of run, or 0.625 psig for the 10 ft of pipe section *A*. This data is listed in Table 1.

To size the suction main, section *B*, we need only be concerned with keeping the total system suction pressure drop within limits. Velocity at minimum load conditions is unimportant since this section of line will pitch in the direction of flow and oil will drain to the compressor regardless of velocity. Since we desire a total suction line drop of 1.8 psig, the main suction line, section *B*, must have a full load drop not exceeding 1.8 — 0.625 or 1.175 psig. This drop in 33 ft is equivalent to 3.525 psig per 100 ft. Entering the chart horizontally at 20 tons, we find that intersection with the 2⅝-inch O.D. line occurs at a point located on the 2,000 fpm slant line and also on the 2 psig pressure loss vertical line. Since this pressure drop is within our limits, a 2⅝-inch O.D. tube will be satisfactory. The pressure drop in this suction main will be 0.66 psig (2 psig/100 ft × 33 ft) and our total system suction line pressure drop will be 1.285 psig, which is the sum of the pressure drops of pipe sections *A* and *B*.

The suction riser for the top coil, section *C*, should have a pressure drop approximately equal to riser *A* so that coil pressures and temperatures will be equal. Therefore, this riser should be selected to give a pressure drop at the minimum load of 7½ tons of 0.35 psig, which for 5 ft of line is equivalent to 7 psig per 100 ft of run. Also, the velocity in this riser must exceed 1,200 fpm at minimum load. To pick a pipe size meeting these requirements, find on the chart the intersection of the 7½ ton horizontal line and the 7 psig vertical line. The nearest pipe size to this is 1⅜-inch O.D., but it can be seen that this size will slightly exceed the pressure drop desired and also will give a full load velocity over 3,000 fpm which tends to be noisy. It would be better to use the next size, 1⅝-inch O.D. From the intersection of the 1⅝-inch O.D. line with the 7½-ton line, we find that this size pipe will have a minimum load velocity of 2,000 fpm; from the intersection of the 10-ton line with 1⅝-inch O.D. line, we find a maximum load pressure drop of 6.25 psig per 100 ft, which is equivalent to 0.3125 psig for 5 ft. We do not have the same pressure drop in the two risers, but the only detrimental effect will be that the coils will operate at slightly different temperatures, less than one degree apart.

Pipe sections *D* and *E* are used when coil loadings require that two connection stubs be used, and they should be of the same size as the coil connection stub.

TABLE 1—PIPE SIZES FOR DESIGN PROBLEM

Section	Length, Feet	O. D., Inches	Pressure Drop Max. Load, Psig	Velocity Min. Load, Fpm
A	10	1⅝	0.625	2,000
B	33	2⅝	0.66	Not important
C	5	1⅝	0.3125	2,000
D	3	Same as coil connection stub		
E	3			

Typical Connections

We have considered first the sizing of the suction line because the procedure and principles are common to all type of systems. Now let us discuss the problems involved in laying out the piping runs with respect to various representative situations. Actually, in designing a system, the layout is made before the pipe is sized since a layout is needed to find lengths of run and number of fittings.

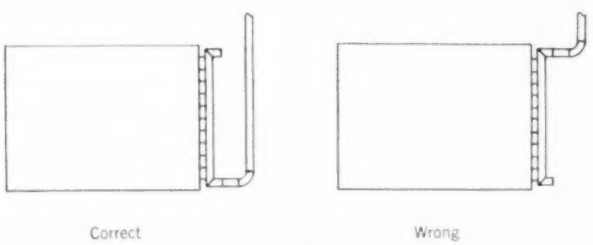


Fig. 3. Suction connections to single D. E. coils.

Direct Expansion Evaporators

Freon evaporators can be classified into three general types, direct expansion, flooded and semi-flooded.

Direct expansion evaporators, or D.E. coils, are the most commonly encountered type and are composed of a finned coil bundle one or more rows deep with multiple parallel circuits. They contain a suction header, normally on the entering air side of the coil, which usually contains a top and bottom connection stub. D.E. coils should always be installed free draining to prevent the accumulation of oil and liquid Freon in the bottom tubes during periods of light load. Such trapping will reduce system efficiency, lower the compressor oil level, and may cause slugging of compressor valves.

To insure that the coil is free draining, it should be installed with a connection stub at the lowest point and the bottom stub should always be connected to the suction line. Fig. 3 shows right and wrong connection to a single evaporator using a single header stub. The coil manufacturer's recommendations should be followed in deciding whether to connect to one or two stubs. This is usually predicated on coil loading. Where two stubs are used, they should be connected as shown in Fig. 2, with the expansion valve control bulb positioned on the vertical riser, as shown. This location allows the bulb a true sensing of temperature leaving the coil, and removes it from the effects of liquid pockets during shut-down conditions without the expense of traps at the coil outlet.

The stacking of two coils with individual suction risers is correctly shown in Fig. 2. The riser from the bottom coil loops and drops into the main to prevent drainage of oil or liquid Freon from the main into the riser during reduced capacity operation, and similarly any suction riser entering a horizontal suction main downstream from another riser should be looped to enter from the top, or from the side above the center line of the main.

Where two or more coils are stacked and connected to a single suction riser and operated on an on-off cycle (without capacity reduction) the correct piping is as shown at *A* of Fig. 4, incorrect at *B*. View *B* is incorrect for there is no trap to collect and remove liquid Freon and oil. This will cause the bottom coil to become oil-logged and lose capacity. Note in *A* that the expansion valve control bulbs are on the lower horizontal stubs, instead of on a vertical riser, and that the piping contains

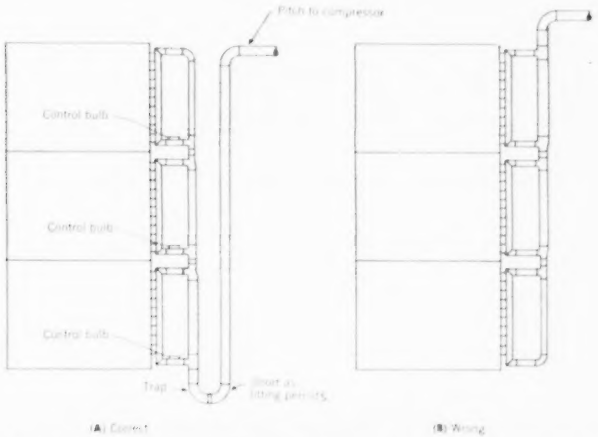


Fig. 4. Suction connections to multiple D. E. coils; no capacity reduction.

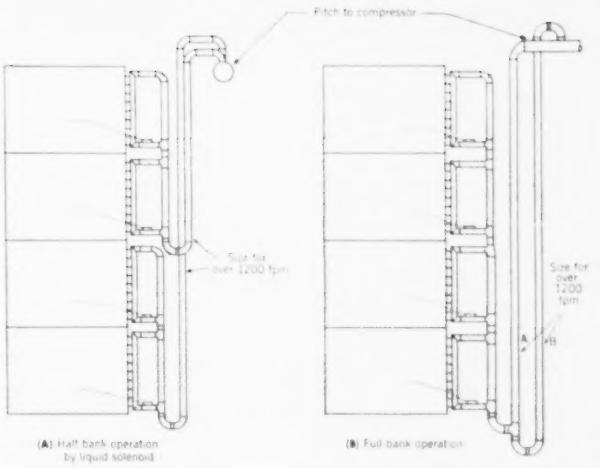


Fig. 5. Suction connections to multiple D. E. coils with capacity reduction.

a trap that Fig. 2 does not have. The bulbs are located on the horizontal stubs to sense individual coil conditions, and on the lower stubs because any liquid Freon leaving the coil would leave from the bottom of the header. Therefore, the trap at the bottom of the bank prevents liquid Freon dropping from the upper coils, from affecting the bottom coils control bulb. This trap is also effective in insuring the collection and removal of oil from the whole coil bank.

If one step of reduced capacity is to be used on a coil bank, the piping should be as shown in Fig. 5. Fig. 5A is applicable where a portion of the coil bank is isolated by liquid line solenoid valves during reduced capacity operation. Note that both sections of the bank are bottom connected and trapped to collect and remove oil, and both risers drop into the suction main. This is permissable, even desirable, but it would be satisfactory to elbow the riser from the top coils into the main as was done in Fig. 2 if this is the first or upstream coil on this main.

The two risers in Fig. 5A are sized to maintain over 1,200 fpm at minimum load on each section of the coil bank, since the liquid line solenoids provide positive one riser operation during reduced capacity operation. If it were desired to operate a coil bank of this size on reduced compressor capacity without isolating part of the bank, it would probably be impossible to select a riser size that would give proper velocity at minimum load conditions and a desirable pressure drop at maximum load conditions. This can be overcome by the use of two risers, connected as shown in Fig. 5B. Both risers are sized for over 1,200 fpm at full load, and riser *A* is sized for over 1,200 fpm at the reduced capacity condition. Both risers will be in operation during the full capacity stage, or as long as the velocity through them exceeds 1,200 fpm. When the system enters the reduced capacity stage, or when the velocity in both risers falls below 1,200 fpm, oil will collect in the trap at the bottom of riser *B* and block it off, allowing flow through riser *A* at velocities over 1,200 fpm. The trap should be as small as fittings permit so as to isolate a minimum quantity of oil, otherwise compressor lubrication may be impaired. When the system returns to full capacity, the increased pressure drop in riser *A* due to excessive velocity will form a pressure differential across riser *B* which will force the oil out of the trap,

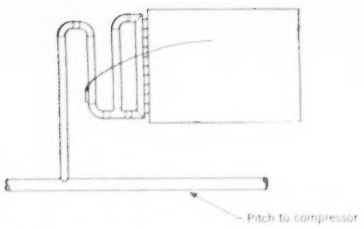


Fig. 6. Suction connection to D. E. coil located above suction main.

gradually, so as not to send a slug back to the compressor to cause possible damage.

When a coil is located above the suction main, it should be piped as shown in Fig. 6 with the suction branch rising to approximately the height of the coil. This is necessary to prevent the drainage of liquid Freon into the main and back to the compressor during the off-cycle, since thermal expansion valves may not make a positive closure on the off-cycle and the pressure differential existing at shut-down will force some Freon into the coil. The use of a pump-down control cycle would take care of this and allow a direct-draining connection of the coil to the main, but it does involve extra controls in the system, extra operating expense, as well as very close-seating compressor valves to be effective.

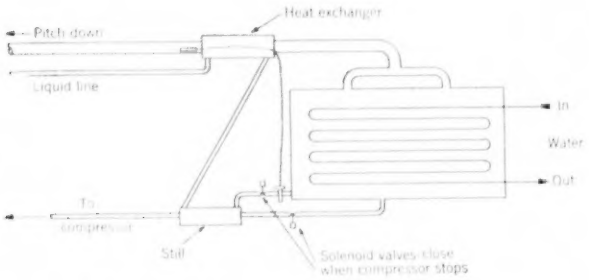


Fig. 7. Flooded evaporator connections.

Flooded Evaporators

There are several designs of flooded evaporators on the market, the majority used for cooling water. Their construction usually involves a refrigerant shell containing bundles of water tubes. Refrigerant control may be by float valve or thermostatic expansion valve. Since water cooling usually involves a close temperature differential between the water and refrigerant, so much surface would be required for superheating within the chiller shell that an externally mounted liquid-to-suction heat exchanger is usually used. The primary problem in piping a flooded evaporator is that of oil return, since the large shell area results in very low gas velocities at the liquid surface. This tends to trap and hold lubricating oil, often necessitating the use of a liquid Freon or hot gas heated "still" to separate and return oil.

Fig. 7 shows a schematic representation of a flooded evaporator, using thermostatic expansion valve control which is normally preferred. The suction connections to the refrigerant shell should be sized so that pickup velocity at minimum load conditions will exceed 1,200 fpm, and this same velocity should be maintained in the horizontal pickup header and vertical header stub. The heat exchanger should be located in the horizontal line as close to the evaporator as possible, and the expansion valve bulb located on the suction line between the heat exchanger and the compressor, so as to give the chiller the benefit of the superheating effect of the heat exchanger. Actually, this is the only bulb location which will give proper system operation, both from the standpoint of system capacity and compressor safety.

Although system operating characteristics are beyond the scope of this article, an explanation of the operation of a flooded evaporator would help in understanding the piping requirements. The system should be run with a superheat setting on the expansion valve of 8 to 12 degrees, no higher, and the system should be charged at full load so that liquid Freon is leaving the condenser 10 degrees sub-cooled. Head pressure should be controlled so as to maintain whatever liquid temperature the heat exchanger was designed for, and a solenoid valve should be installed in the liquid line at the evaporator to close when the compressor stops. At full load there will be some turbulence in the evaporator, more or less, depending on the ratio of cross section area to depth, which will throw oil and liquid Freon into the leaving gas stream. The oil will be carried back to the compressor and the liquid Freon will be evaporated in the heat exchanger. As the load decreases, the turbulence will decrease, but the expansion valve will feed more refrigerant in an attempt to maintain its superheat setting, thereby raising the evaporator liquid level and maintaining the oil-Freon pickup by the suction gas flow. The maximum height of Freon in the evaporator is controlled by the amount of charge in the system, and should be reached at approximately the compressor shut-off point.

When the compressor restarts, there may be some liquid Freon returned from the evaporator until the heat exchanger warms up, but the first liquid Freon which contacts the expansion valve bulb will cause the valve to close and prevent the admission of Freon to the evaporator until the level has been reduced to the correct operating point. If liquid Freon returning to the compressor in this start-up period damages, or slugs compressor valve reeds, a suction line accumulator should be used. With most compressors, this Freon return will not cause valve damage. Experience indicates that small amounts of liquid Freon can be passed through the reeds of compressor valves without trouble, but damage results when the liquid Freon hits the hot cylinder heads and flashes into a gas. This pressure surge, cups and breaks valve reeds. Under this start-up condition, the cylinder heads are relatively cold and the liquid Freon passes into the discharge line without causing damage.

If the evaporator has a high ratio of cross section area to depth, there may not be enough turbulence to obtain oil return under any conditions. If this is the case, a still must be used and piped as shown in Fig. 7. A small condenser, or a heat exchanger, with capacity equal to that recommended by the evaporator manufacturer, will serve

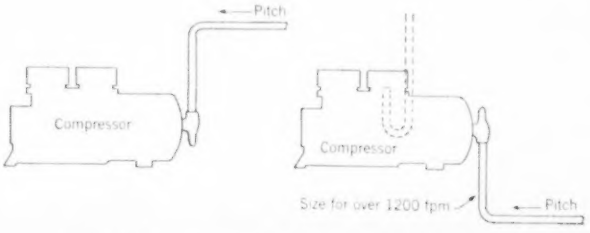


Fig. 8. Suction connections to single compressor.

as a satisfactory still. The heat source can be either liquid Freon or hot gas, and the oil return line to the compressor crankcase should be as direct and unobstructed as possible, and approximately one-fifth the diameter of the suction line.

Semi-Flooded Evaporators

This is a miscellaneous classification, composed of refrigerant-shell water-tube evaporators with a low ratio of cross section area to height; so called dry expansion water coolers; parallel finned water-tube Freon-tube water coolers; or almost any close temperature differential evaporator not classified as flooded. The main requirements are an external liquid to suction heat exchanger, suction connections and risers sized for over 1,200 fpm at minimum load, and location of the expansion valve bulb between heat exchanger and compressor. The operating characteristics are very similar to a flooded chiller, but due to the smaller volume of liquid refrigerant employed, and the greater agitation and higher velocities obtained, a still is not necessary for proper oil return and an accumulator is seldom required to protect the compressor from slugging.

Compressor Connections

The method of connecting suction lines to the compressor or compressors is very important to the proper operation of the compressor itself. There will be some variation in the methods of making such connections, depending on the construction of the compressor. Basically, there are two general types, those in which the suction gas flows through a hermetically sealed motor before entering the compressor head valves (gas cooled hermetic), and those in which the suction gas flows directly into the cylinder head containing the compressor valves.

Single Compressors

Fig. 8 shows suction line connections to a single compressor. Either of the connections shown by solid lines is acceptable for any type of compressor. As long as the vertical risers are sized properly, and horizontal lines are pitched to the compressor, oil will return satisfactorily during operation. During the off-cycle, assuming there is a properly trapped evaporator, a small amount of oil will drain into the compressor in one case, or collect in the line in the other. This amount of oil will be so small that even with a compressor having a head-connected suction line, there will be no valve damage on the next start.

A trap in the suction line at the compressor, as shown by the dotted lines in Fig. 8, should be avoided on compressors having cylinder head connection, since oil collecting during shut-down could block such a trap, and on the next start be sucked into the compressor as a valve-damaging slug.

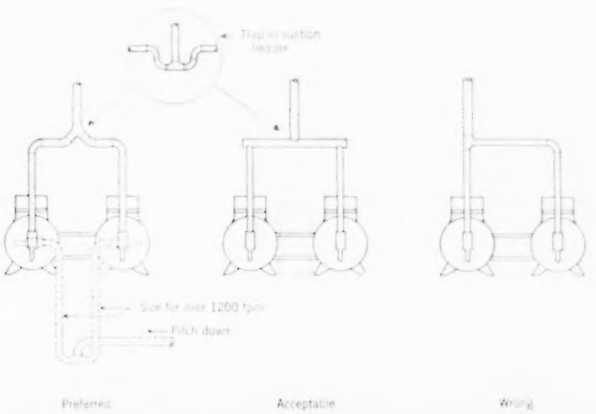


Fig. 9. Suction connections to two compressors in parallel.

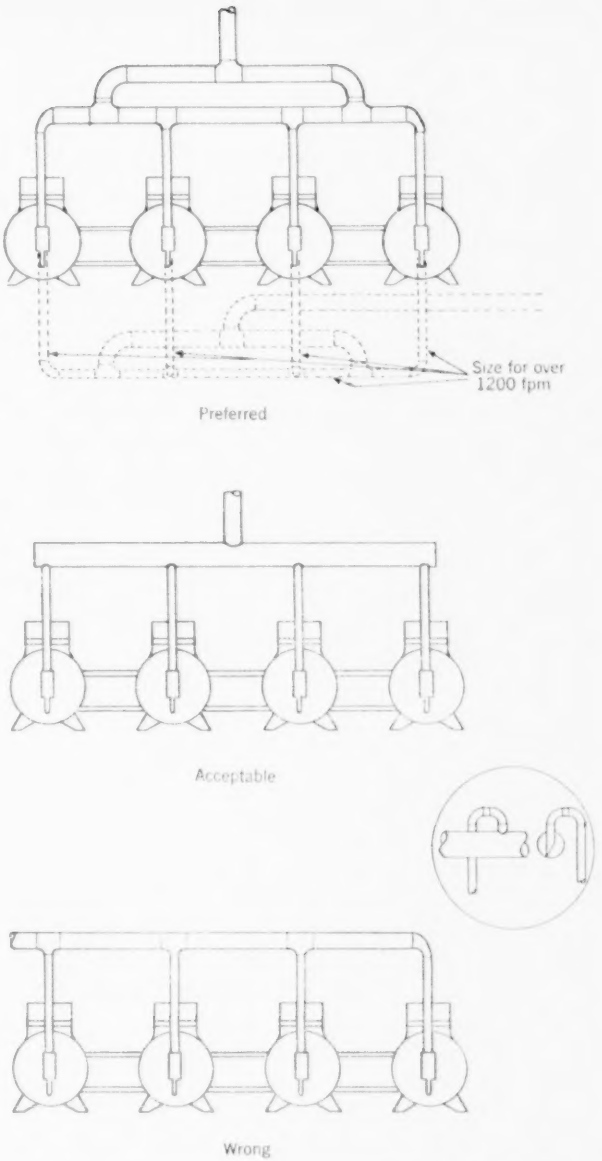


Fig. 10. Connections from single suction main to parallel compressors.

Parallel Compressors

The paralleling of compressors is a common practice and is a convenient way of obtaining multiple steps of load or capacity variation. The suction piping to paralleled compressors is extremely important to insure successful operation. The special requirements of paralleled compressors which must be supplied by the suction piping are (1) that all compressors run at the same suction

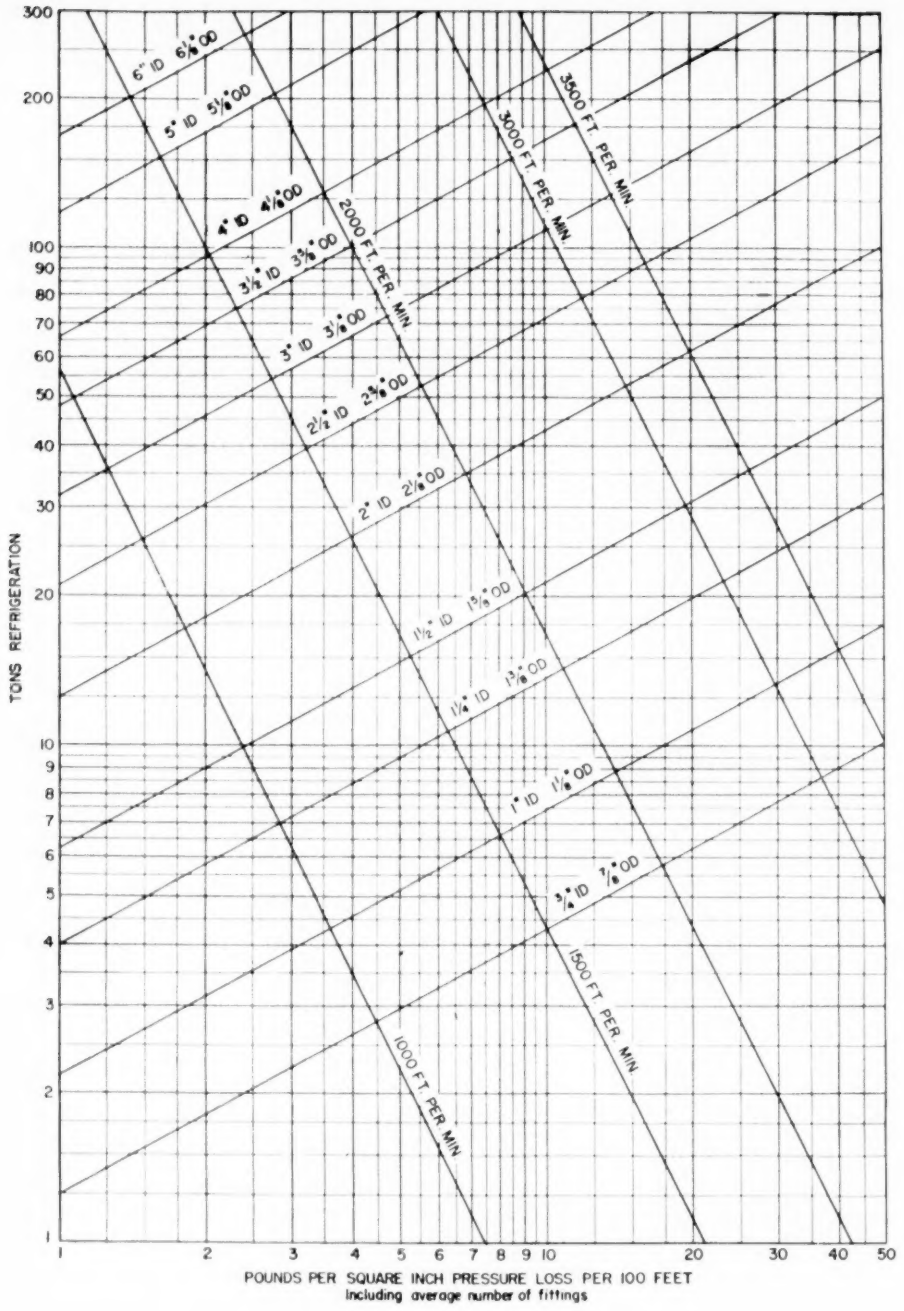

TONS REFRIGERATION
POUNDS PER SQUARE INCH PRESSURE LOSS PER 100 FEET
Including average number of fittings
6" ID 6⅝" OD
5" ID 5⅛" OD
4" ID 4⅛" OD
3½" ID 3⅝" OD
3" ID 3⅛" OD
2½" ID 2⅝" OD
2" ID 2⅛" OD
1½" ID 1⅝" OD
1¼" ID 1⅜" OD
1" ID 1⅛" OD
¾" ID ⅞" OD
3500 FT. PER MIN.
3000 FT. PER MIN.
2000 FT. PER MIN.
1500 FT. PER MIN.
1000 FT. PER MIN.

Fig. 11. Hot gas discharge line Freon vapor pressure drop, based on 100 to 150 psi condensing pressure. Recommended velocity 2,000 to 3,500 fpm; recommended pressure loss in system discharge lines, 3 to 4 psi.

pressure and same crankcase pressure and (2) that oil return is equally proportioned among all running compressors. Fig. 9 and 10 illustrate preferred and acceptable methods of accomplishing this for two or more compressors in parallel, and a wrong method.

Crankcase equalizer lines, one at the normal oil level and one above it, are shown in these figures and must be used between paralleled compressors to insure that one compressor does not rob oil from another. With an equalizer line at the oil level, a slight difference in suction, or crankcase, pressure between two compressors will result in a large difference in oil levels, approximately 1 ft for each 0.4 psig difference. This is the reason for the requirement that paralleled compressors run at the same suction pressure. The equalizer line above the oil level is used to equalize crankcase gas pressures, and compensates for the pressure difference which would otherwise exist when one compressor is shut down. Equalizer lines should be as short as possible and as large as or larger than the connection supplied on the compressor. They should preferably be run in a horizontal plane although satisfactory operation will be obtained if they are run as indicated by the dotted line in Fig. 9. If the equalizer lines contain shut-off valves, the valves should be of a type which will permit flow in both directions with as little pressure drop as possible. Further, for the equalizer lines to operate properly, it is necessary that the paralleled compressors be installed with their normal oil levels in the same plane, and as close to each other as practical.

The preferred methods illustrated in Fig. 9 and 10 pro-

vide balanced piping runs to each compressor from a single suction main, which assures that all compressors will run at the same suction pressure and that oil will return equally to each running compressor. In the case shown in Fig. 10, pyramidal headering must be used to obtain balanced runs and such headers should be of the same size as the suction main. The suction main should in all cases enter the header from the top or side, since if it entered from the bottom it would be too big for proper oil lift during periods of reduced compressor capacity. If the suction main is below the compressor, preferred piping would be as shown by the dotted lines.

So far, we have considered the paralleling of compressors with gas-cooled motors only. If the preferred piping of Fig. 9 and 10 were applied to a compressor with a cylinder head connected suction line, a certain amount of oil would drain down the suction riser of an idle compressor, rather than all of it going to the running compressors, and cause head valve damage on the next start. To prevent this, a trap must be built into the suction header, as illustrated in the small inset of Fig. 9. This trap must be as small as fittings permit, since if it is allowed to collect too great a volume of oil, a slug might be created on the next start of the idle compressor. This problem does not arise with the compressor having a gas cooled motor, since the oil will drain into the motor compartment which is a part of the crankcase.

The acceptable method shown in Fig. 9 and 10 has a single header made without fittings, but to be acceptable, it is necessary that the horizontal header have an area equal to twice the combined areas of the individual suction risers, or the nearest pipe size to this. Such a large area is necessary to minimize pressure drop and to allow as nearly equal distribution as is possible with this construction. Again, the suction main should enter the header from the top or side, and centered on the header as close as possible. If necessary to run it below the compressors, the construction shown in dotted lines should be used. The acceptable method applies to the gas-cooled motor compressor only. For the cylinder head connected compressor, traps must be provided as shown in the insets.

The wrong method of Fig. 9 features unbalanced piping runs which will cause unbalanced suction pressures at the compressor. The tee location creates a separating action which will result in all of the oil being returned to the left-hand compressor, regardless of which is running. The wrong method of Fig. 10 results in each compressor running at a different suction pressure, and also in all of the oil being returned to one or the other of the end compressors, which end depending on the velocity in the main. At a high velocity, oil will be returned to the right hand compressor and at a low velocity it will drain into the left hand compressor.

Discharge Lines

In the compressor discharge line, or hot gas line, we encounter the same oil transportation problem as in the suction line. To insure adequate oil return, therefore, gas velocities should be kept above 1,200 fpm in vertical risers, and horizontal piping should be pitched in the direction of gas flow. The maximum allowable pressure drop in the system discharge line is 3 to 4 psig. Pressure drop in the discharge line is not as detrimental to compressor capacity as it is in the suction line, but it must be limited because it increases the compressor's power consumption.

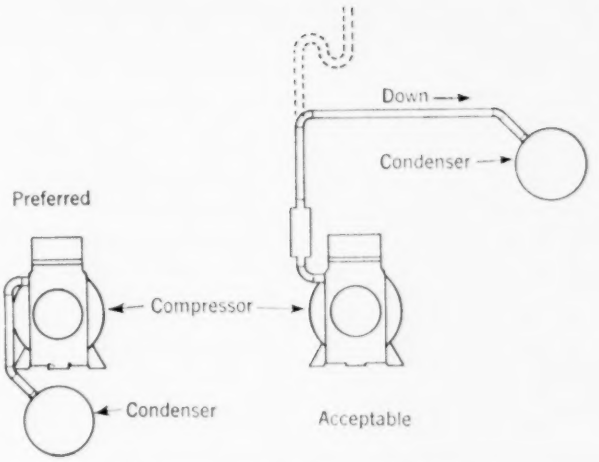


Fig. 12. Discharge line connection to single compressor.

Fig. 11 presents a graph method of selecting pipe sizes for discharge lines, similar to the graph shown in Fig. 1. It is based on conditions from 100 to 150 psig condensing pressure. Pressure drops are shown per 100 ft of run, including an average number of fittings. The selection of pipe sizes from this graph is performed in the manner already detailed for suction lines.

In actual practice, 2,000 to 3,500 fpm discharge line velocities are employed. Such velocities insure positive oil movement and do not result in excessive pressure drop since most discharge lines are relatively short. Noise is the limiting factor, since discharge gas flow is subject to compressor pulsation, which combined with high velocity, can produce objectionable noises and vibration, even to the extent of breaking pipe joints.

Compressor Connections

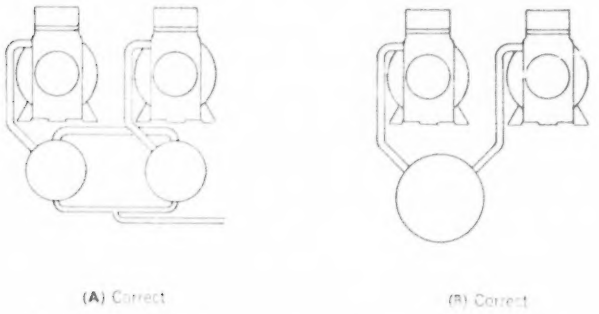
The following figures illustrate the various typical connection problems, encountered in running discharge lines, and their solution, and are applicable to almost any type of compressor.

Fig. 12 indicates the acceptable methods of running a discharge line between a single compressor and a water cooled condenser. The preferred method is to locate the condenser just below the compressor by means of special mounting feet or an angle iron framework. If this is done, the discharge line will be short and a muffler will not be required, since the condenser will absorb the gas pulsations. Any oil in the discharge line at shut-down will drain away from the compressor head valves and into the condenser.

If it is impossible to locate the condenser under the compressor, piping should be as shown in the sketch labeled "acceptable." In this case, a muffler is usually required to absorb gas pulsations and prevent excessive line vibration, and should be located directly at the compressor. If the condenser must be above the compressor, the full vertical pipe rise should be taken at the compressor, and the horizontal run pitched to the condenser. On shutdown, whatever oil is left in the vertical pipe and Freon that condenses will drain back to the compressor. But if the vertical run does not exceed approximately

10 ft the quantity will not be enough to cause valve damage on the next start. If the vertical run exceeds 10 ft, a trap should be provided as shown by the dotted lines of Fig. 12, and an additional trap for each additional 10 ft of rise. These traps will collect shut-down oil and Freon in small quantities, rather than allowing a large quantity to collect at the compressor head valve with resultant damage on the next start. Traps should be as small as fittings permit, and usually are made from four 90 degree ells. Multiple small traps are preferable to a single large trap, since the large trap could collect enough oil so that the static head of the oil column plus the pressure required to overcome inertia could exceed the setting of protective devices on the next start. This could require the resetting of pressure cutouts one or more times to get the compressor running, or even the replacement of rupture discs.

Fig. 13 shows the discharge line requirements of paralleled compressors. In sketch *A* there are two compressors with their own condensers. The discharge lines are run as in the case of a single compressor and condenser,



(A) Correct (B) Correct

Fig. 13. Discharge line connections to parallel compressors.

but should be equal in pressure drop. Since the refrigerant system becomes common at the liquid line, a manometer effect is created and a difference of pressure in the two condensers of less than 1 psig can result in a difference in liquid level of more than a foot. This would cause a loss of condensing capacity in the high level condenser, and the admission of hot gas into the liquid outlet of the low level condenser. To prevent this condition, particularly when only one compressor is running, paralled condensers must be connected by an equalizer line, as shown in Fig. 13A. This line may be connected to fittings

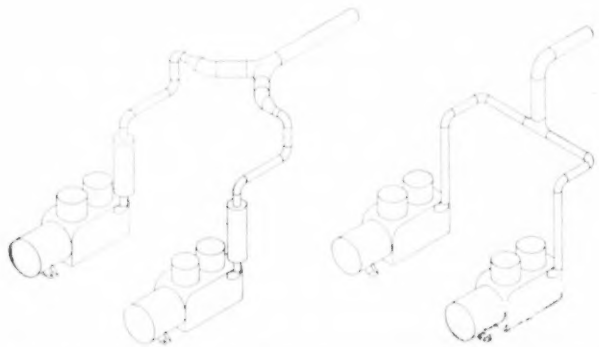


Fig. 14. Discharge line connections to parallel compressors. Correct method, left; wrong at right.

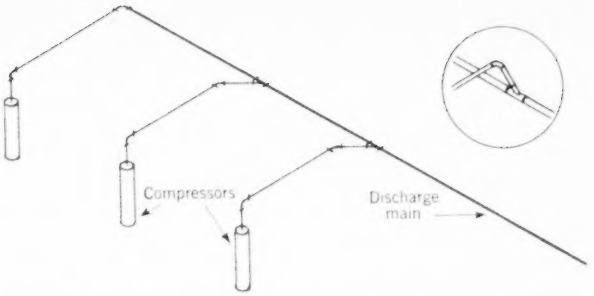


Fig. 15. Discharge line connections to multiple compressors in parallel.

provided on top of some condensers, or connected into the discharge lines as close as possible to the condenser. To work properly, the line should be as large as, or larger than, the discharge line and be as short as possible. If it contains a shut-off valve, which is desirable so each half of the system can be isolated, it should be of a bi-directional full flow type.

In addition to equalizing paralleled condensers, their water supply should be designed to maintain equal head pressure. If automatic water regulating valves are used, as is customary on city water installations, their control points should be identical so they will compensate for slight differences in discharge line pressure loss. If automatic water valves are not used, as on most cooling tower installations, the water flow to each condenser must be accurately balanced and in this case proper equalization and balanced pressure drops become of more value.

Fig. 13B shows discharge piping for two compressors and a single, double inlet condenser located near the compressors. Equalization is no problem here, but the compressor discharge lines should have identical drops to provide equal compressor performance. For different locations of this condenser with respect to compressors, principles discussed for a single compressor would apply.

Fig. 14 shows correct and wrong methods of running discharge lines from two paralleled compressors to one or more remote water-cooled or evaporative condensers. The correct method involves the use of mufflers at the compressor to reduce line vibrations. The full vertical rise is taken by each branch line before connecting it to the common main, although this may be done in one or more vertical steps. If two are used, as shown, the first horizontal run should be pitched in the direction of flow. This will form a shallow trap to collect oil and Freon during shut-down from the next vertical section. The branch lines should be sized for over 1,200 fpm to ensure oil entrainment, and the trapping rule given for single compressors will apply when the vertical rise exceeds 10 ft. Branch lines come together into the main with a Y-fitting which serves to reduce gas turbulence, providing low pressure drop, less noise and vibration. It also prevents flow of oil into the branch piping of an idle compressor. The discharge main should slope down in the direction of flow so as to drain into the condenser.

The wrong method shown in Fig. 14 is one that is commonly encountered. Here part of the vertical rise is taken by the main, and at reduced capacity operation, velocities will probably be too low. Also, the use of a tee at the juncture of branches and main will produce gas turbulence, with accompanying high pressure drop

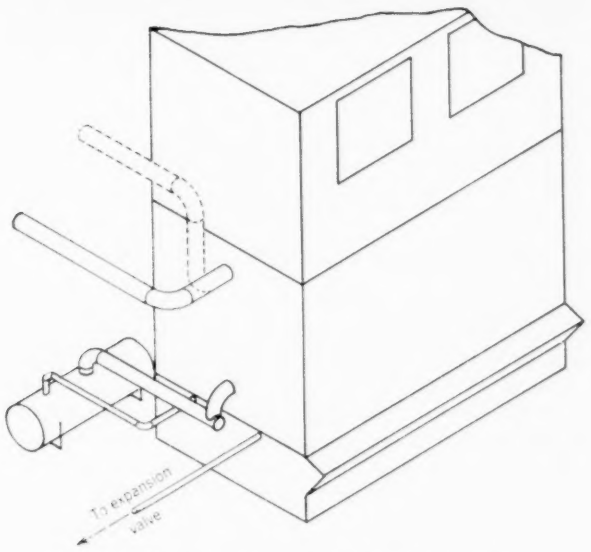


Fig. 16. Single evaporative condenser connections.

and excessive noise and vibration. Worst of all, it provides a separating action for oil particles when one compressor is running. This oil will enter the branch line of the idle compressor, and could very easily be of sufficient quantity to cause trouble on the next start, or to reduce the oil level of the running compressor to a dangerous point.

Very often equipment room dimensions require that two or more compressors be located as shown in Fig. 15, connected to a common discharge main running to one or more condensers at the other end of the room. When this is done, the main should be run full size all the way so as to minimize the differences in pressure drop which would otherwise be appreciable. The velocity in the main is unimportant, since it must be pitched down in the direction of flow to insure that no oil drains into an idle compressor. To further guard against this, and to minimize pressure drop and vibrations due to turbulence, all branch lines except the first should enter the main through either a 45 degree ell and Y fitting in the horizontal plane, or a 90 degree ell and Y fitting in a vertical plane. The inset shows the connection to the discharge main, in greater detail.

Evaporative Condenser Connections

The connection of a single discharge line, from one or more compressors, to an evaporative condenser with a single coil presents no complications, and is illustrated in Fig. 16. Either of two constructions is satisfactory—directly connected as shown in solid lines, or with a vertical drop at the condenser as in dotted lines, providing that all horizontal runs pitch toward the condenser.

Typical connections of a discharge main to an evaporative condenser having two or more coil sections are shown in Fig. 17. The preferred method, *A*, involves pyramidal headering, and will provide balanced runs and equal distribution of refrigerant and oil to all coil sections. Sketch *B* is an acceptable method which is less expensive and will give satisfactory distribution if the header size is equal to the discharge main size. Sketch *C* is also acceptable, although it tends to send most of the oil into the end coil. This will create a slight unbalance between the capacities of the coil sections. Freon distribution to the coils will be as good as with any other method if a reverse-return connection is created by the coil outlet piping, as indicated in the sketch. The piping shown by dotted lines is discussed later.

Several general problems are encountered with long discharge lines having a good bit of vertical lift. One of these is condensation of liquid Freon during shut-down and this is most bothersome on systems having an evaporative condenser located outdoors. Condensation in the outdoors portion of the discharge line and condenser coil during cold weather is not bothersome, since piping will be pitched so as to drain the liquid Freon into the liquid receiver, and any that does drain down the inside discharge line will be re-evaporated by the normal building heat. However, in hot weather the evaporative condenser and outside piping may be much warmer than the inside piping. This condition will raise the pressure in the outside parts of the system, driving Freon into the cooler inside piping where it may condense. If the liquid receiver is outside with the evaporative condenser, the trouble will be much worse. The solution to the problem is to locate the evaporative condenser so it is protected from high temperatures, or in some cases to insulate the discharge lines.

A good example of the condensation problem and the troubles that can be caused by incorrect piping is shown in Fig. 18. This is a sketch of an actual installation in which the compressor was installed in a subgrade equipment room, with evaporative condensers on the ground just outside. Since the condenser location was a hot one, and piping runs were long, the designer included the large tank in the discharge line to serve as a combination

Fig. 17. Discharge line connections to multiple coil evaporative condenser.

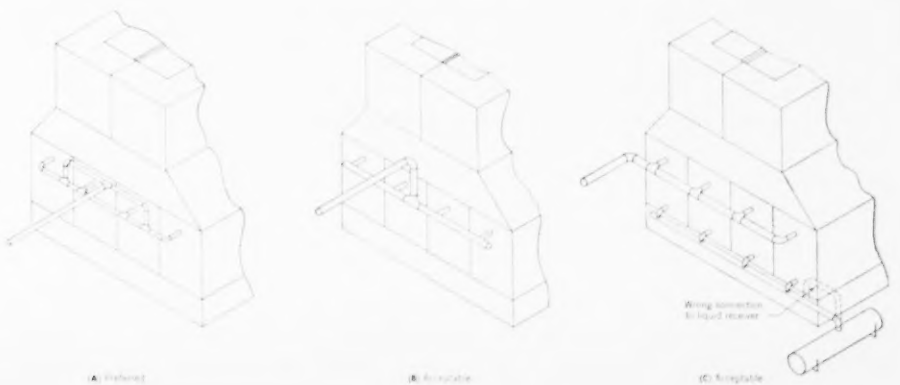


TABLE 2—LIQUID LINE SIZES

Tons Refrigeration	1	2	3	5	7½	10	15	20	25	40	60	75	100
Nominal Size, Inches	¼	¼	⅜	⅜	⅝	⅝	¾	¾	¾	1¼	1¼	1½	1½
O. D., Inches	⅜	⅜	½	½	¾	¾	⅞	⅞	⅞	1⅜	1⅜	1⅝	1⅝

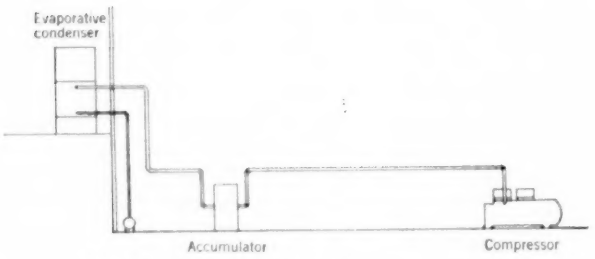


Fig. 18. Errors in discharge line connections.

surge tank and liquid accumulator. A short while after the system was started it was found to be low on Freon and oil. Both were added. This happened again, and again, until the system contained twice as much oil and Freon as a system of that size should need. About this time, trouble commenced. The compressor was protected by a high to low side rupture disc which blew on start-up. After blowing a dozen discs, an analysis of the layout was made, and it was found that the accumulator tank was half full of liquid Freon and oil. Evidently on every shut-down, a certain amount of Freon and oil collected in the tank, and since the gas flow was over this level, it was not driven out. The tank never warmed up enough to evaporate the Freon. Of course, the oil would never have left this tank. As soon as the level built up to the line connection point, each shut-down would result in the formation of a column of liquid Freon and oil in the discharge pipe at the accumulator, and the pressure required to start this column moving would exceed the rupture disc setting.

The solution was to remove the accumulator. With the liquid receiver indoors, it was found that the temperature difference was such that the pitched, horizontal discharge line could safely hold all of the shut-down condensation. If the temperature difference had been greater, it would have been necessary to insulate or otherwise protect the evaporative condenser from the sun load, or even to insulate the inside discharge lines. A check valve in the discharge line is sometimes used in such a case, but it should be the last resort. In large sizes, check valves are expensive and troublesome.

Sometimes it is impossible to take the full vertical rise on the branch lines, and it must be done with a discharge main. If the lines are long, pressure drop limitations may require the main to be large enough so that at minimum load the velocity would be below the 1,200 fpm required for oil return. There are two solutions. One is the use of an oil separator with each compressor, installed as described under "Accessories." This will reduce the oil content of the Freon flowing through it, and permit low velocities in the discharge riser. The other solution is to employ a trapped double riser, similar to that shown in Fig. 5B for suction lines, which will operate automatically through load changes to maintain desired riser velocities.

Liquid Lines

The liquid line presents the fewest problems of all, since liquid Freon 12 and oil are miscible in all proportions. This means that the oil will not separate from the Freon, and will be carried through the system at any velocity. Liquid line pressure drop is usually held to a maximum of 5 psig. Pressure drop in the liquid line is not as critical as in other lines, but it must not be so great as to cause flashing, or loss of sub-cooling.

Table 2 gives commonly used liquid line sizes, which are satisfactory up to 100 ft of pipe including an average number of fittings. These conditions will cover most installations. Where an installation involves greater piping runs, the next size line should be used. Liquid Freon should leave the condenser at least 10 degrees sub-cooled, and should reach the expansion valve with at least 3 degrees of sub-cooling to prevent the loss of valve capacity resulting when it handles flash gas. Since there is usually very little heat gain in a liquid line, loss of sub-cooling can only come about from frictional pressure drop or vertical lift.

Fig. 19 presents a curve showing the relationship between condensing pressure and safe vertical lift. The curve is based on liquid leaving the condenser 10 degrees sub-cooled and the liquid line in an ambient temperature of 95F. The break in the curve is the point at which liquid temperature exceeds the ambient and above it there will be a heat loss which is the equivalent of additional sub-cooling.

To illustrate the use of Table 2 and Fig. 19, assume a 20-ton system having 76 ft of liquid line, including a

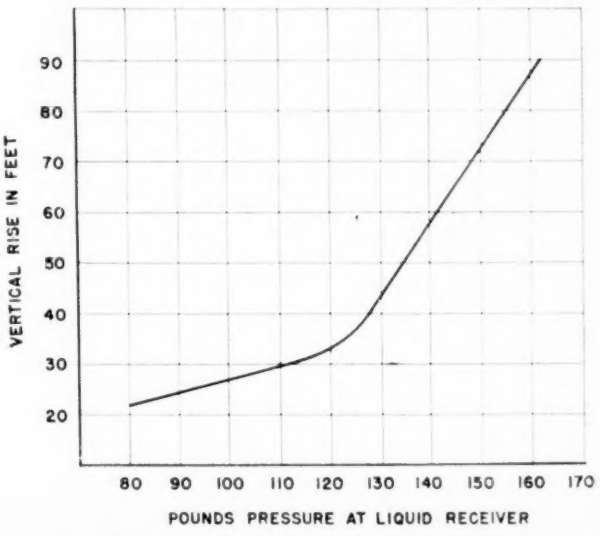


Fig. 19. Liquid line vertical rise chart.

30 ft lift, in an ambient of 80F. System is designed for 120 psig condensing pressure and liquid is sub-cooled 10 degrees. The length of tube is within the conditions covered by Table 1 and a ⅞-inch O.D. line would be indicated, but our lift must be considered. Reference to Fig. 19 indicates that a lift of 30 ft is safe at a condensing pressure of 110 psig. Since we have designed this particular system for 120 psig condensing pressure with liquid sub-cooled 10 degrees, it will handle the 30 ft lift and a ⅞-inch O.D. line will be satisfactory. We have not considered the ambient temperature, since it is below the curve basis of 95F and represents a safety factor. If it exceeded 95F, higher condensing pressure or a greater amount of sub-cooling would be required for the same vertical rise.

Fig. 19 is based on a maximum safe vertical rise with liquid sub-cooled 10F at receiver outlet. It does not include excessive pressure losses in pipe and fittings. The curve is based on 95F ambient temperature and is useful in solving design problems.

Fig. 20 shows the preferred method of running a liquid line from a water cooled condenser to one or more expansion valves on a coil bank. The line takes its full rise at the condenser and then drops down to the expansion valves. Downward flow to expansion valves is desirable since it assures an even distribution of sub-cooled liquid to each valve. The vertical lift involved here is the distance A-B. A wrong method is shown by the dotted lines. Upward feed in this case will result in the top valve receiving most of the flash gas that may be present in the liquid line and starving the coil. Also, it is not good practice to run a liquid line across the floor where it is exposed to damage. If this must be done, the line should be enclosed in protective conduit of some type.

In some cases involving long vertical lifts between evaporators, downward flow to a group of expansion valves will result in excessive piping runs. In such a case the construction shown to the right of the evaporators in Fig. 20 may be employed. This will distribute flash gas equally to all expansion valves and maintain balanced evaporator capacities. An even better solution is to design for the proper combination of condensing pressure, sub-cooling and pressure drop so there will be no flash gas during operation. If the condenser cannot give the desired degrees of sub-cooling without a loss of condensing capacity, one or more liquid-to-suction heat exchangers may be used. If this is done, a small heat exchanger should be installed at each evaporator so as to sub-cool the liquid just before entering the expansion valve.

The most serious errors in liquid piping are usually made when using evaporative condensers. Fig. 16 shows such a condenser completely piped in the proper way. This condenser contains a separate sub-cooling coil. The

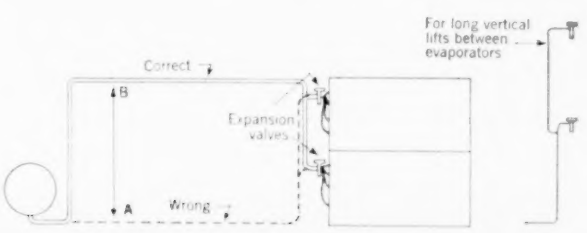


Fig. 20. Liquid line connections.

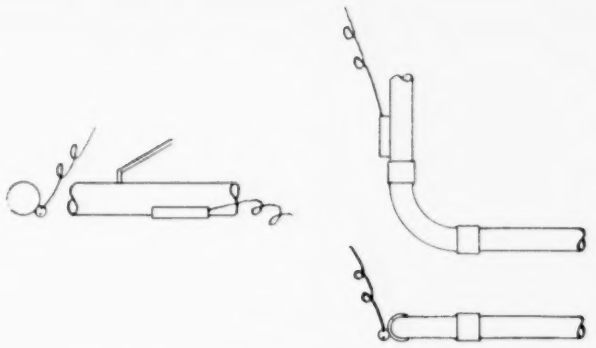


Fig. 21. Locations for the expansion valve bulb.

proper sequence of flow is saturated liquid from the bottom connection of the condensing coil to the liquid receiver, saturated liquid from the bottom of the receiver to the sub-cooling coil inlet and sub-cooled liquid from the sub-cooling coil outlet to the expansion valves. If it were piped the other way, that is from the condensing coil to the sub-cooling coil and thence to the receiver, it would be necessary to operate with the receiver almost full of liquid before sub-cooled Freon could be obtained in the liquid line. This requires an excessive amount of Freon in the system and results in a loss of liquid receiver pump-down capacity. The reason is that liquid in contact with gas cannot be kept sub-cooled unless there is constant heat removal from the liquid, as is done in a water cooled condenser.

Where an evaporative condenser is used without a separate sub-cooling coil, sub-cooling can be obtained by charging the system so the bottom tubes of the condensing coil contain liquid, and connecting the coil outlet directly to the liquid line. The condenser must be selected to have sufficient condensing capacity when this is done. A receiver is usually installed for pump-down storage, but is isolated by shut-off valves during operation.

The method of making the liquid connection from the condensing coil outlet to the liquid receiver is important. The correct method is shown in Fig. 16 and 17. In each case the outlets drop into a header which is free-draining to the receiver. This provides drainage of liquid refrigerant into the receiver. Incorrect piping is shown by the dotted lines of Fig. 17C. The hump in the line forms a trap which will back liquid Freon into the bottom tubes of the condensing coil, reducing the condensing capacity. Since there is practically no pressure differential between the condenser coil and the receiver to keep such a trap blown clear, this construction must be avoided.

So far, we have covered in detail piping between the major system components, compressor, condenser, and evaporator, with an occasional mention of the proper use of accessories where necessary. It is advisable that a few of these accessories be covered in detail.

Expansion Valves

Although we have already covered the proper location of expansion valve control bulbs for various types of systems, the expansion valve itself deserves a more thorough study. An expansion valve is a super-heat control device, and to control super-heat it regulates the flow of Freon into an evaporator so that the rate of admission

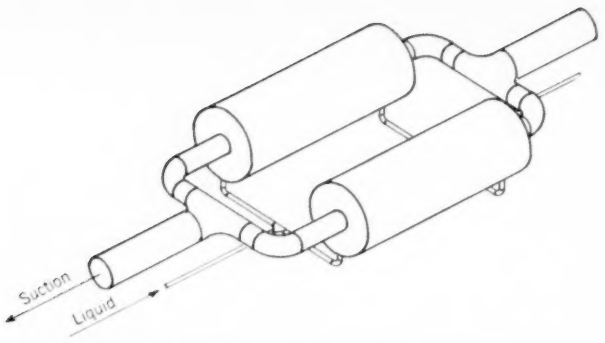


Fig. 22. Parallel heat exchanger installation.

is equal to the rate of evaporation. The valve body contains an orifice and a moving stem which regulates the flow opening, positioned by a diaphragm against which bulb pressure acts. Connected to the valve, or made a part of it, is a distributor to divide the liquid Freon evenly between the various coil circuits.

Pressure supplied by the bulb to modulate the valve is a function of the bulb temperature, therefore it is necessary that the bulb be located so as to sense a temperature representative of average suction gas conditions. General locations have already been shown, and the exact spot to which the bulb is clamped can only be determined by trial and error. However, there are some general rules that are applicable and are illustrated in Fig. 21.

(1) A bulb located on a horizontal line should be located approximately 45 degrees up from the bottom of a large line, or at the coldest point around the periphery, but never on the bottom of the line. Usually, during shut-down, there is a small amount of liquid Freon on the bottom of the suction line which would give the bulb a false indication.
(2) A bulb located on a vertical line should be located at the coldest point around the line.
(3) A bulb located on a vertical or horizontal line, just beyond an elbow should be located on the outside of the bend; on the pipe center line if the elbow is in the vertical plane, slightly below the center line if the elbow is in the horizontal plane. Liquid Freon is thrown to the outside of a bend, in the same way solids are carried by air flowing in a duct.
(4) A bulb should always be installed with the capillary connection at the top to prevent any condensed power charge from draining from the bulb onto the diaphragm.
(5) External equalizer lines, when used, should be connected to the suction line near the bulb location, but downstream from it. The equalizer line sometimes dribbles liquid Freon from the valve and if it were connected upstream from the bulb this leakage might give the bulb a false sensing.
(6) Follow valve maker's instructions as to whether bulb should be in or out of the conditioned air stream, insulated or uninsulated. This varies depending on the type of system and type of valve.

The valve manufacturers recommendations should also be followed in mounting the valve itself. However, they are usually mounted so that Freon flows vertically up or down, through the distributor. This provides more even distribution of refrigerant to the coil circuits than horizontal flow, since with horizontal flow at light loads the distributor tubes leaving the top of the distributor will receive all of the flash gas.

In selecting valve sizes, make sure that the valve rating is proper for both maximum and minimum system loads. An overloaded valve will restrict system capacity; an underloaded valve will lose control, hunt, and allow flooding.

The amount of superheat is adjustable on most valves, by means of a packed stem. Extreme caution should be employed in adjusting superheat. Valve maker's literature will indicate the number of turns to make per degree change, and it is advisable to make the total desired change in several steps, letting the system stabilize after each step and measuring the superheat. Never set a valve at less than 5 degrees superheat, since occasional wet return would result. Most valves operate from full open to closed on a swing of approximately 4 degrees.

Strainers

At least two strainers are included in any good piping system, one in the liquid line and one in the suction line. The liquid strainer should contain a 100 mesh, large area screen and it may be located anywhere in the line between the condenser and expansion valves. Its purpose is to prevent chips and scale from the compressor, condenser, or piping from interfering with expansion valve operation. Very often this strainer is combined with a Freon flow sight glass assembly. If so, it may be located near the condenser if the liquid line is short. If the liquid line is long or includes a high lift, the strainer-sight glass assembly should be located near the expansion valve. This enables the service man to make a positive check for flash gas at the valve.

Most compressors contain a built-in suction screen. If it is of large enough area to collect and hold the expected scale without causing too great a pressure drop, an external strainer need not be used. However, it is generally advisable to use an external, cleanable strainer to preclude the necessity of opening the compressor to clean the strainer. An external strainer, including a 100 mesh screen and cloth bag, which is removed after one or two days of operation, must always be used with a welded steel suction line.

Heat Exchangers

Liquid-to-suction heat exchangers are required with flooded or semi-flooded evaporators and may be needed on other systems to meet specific purposes. The simplest type of heat exchanger is that made by strapping or soldering the suction and liquid lines together so counter flow is obtained and by insulating the lines as a unit. To obtain the greatest capacity the liquid line should always be on the bottom of the suction line, since liquid Freon in a suction line runs along the bottom.

For larger systems and greater capacity, shell and tube heat exchangers are employed. Fig. 22 shows a typical mounting of two such heat exchangers, paralleled to give the total desired capacity. Note that both suction and liquid connections are balanced to provide equal pressure drop, and equal flow through the exchangers. They are mounted with liquid connections at the bottom so that liquid will drain from the exchangers when pumping

down. If they were on top, and the exchangers were insulated as they usually are, it would take a long time to empty them when pumping down.

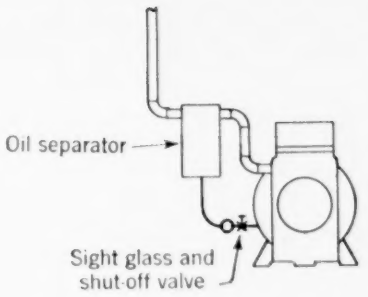
Oil Separators

An oil separator is required with each compressor or system employing flooded or semi-flooded evaporators, and as previously mentioned certain piping problems may require the use of an oil separator. A certain amount of oil will always be circulated with Freon and most performance data is based on this fact. However, as the amount of oil circulating with Freon increases there will be an increase in the saturation temperature of the mixture at a given pressure. Quantitatively, an increase in oil circulation from 0 to 40% by weight, at a constant pressure will raise the mixture saturation temperature 10F. In this case, a temperature measurement on the suction line compared to the Freon 12 saturation curve would indicate a 10F superheat, whereas there would actually be no superheat and the system would be running wet. In addition, an increase in oil circulation tends to insulate the evaporator surfaces and reduce heat transfer, as well as lowering the capacity of the expansion valve.

It is obvious that it is desirable to limit the amount of oil circulating with Freon, and even though no oil separator will remove 100% of the circulating oil, the amount that is removed justifies their use.

Oil separators should be installed in the discharge line as close as possible to the compressor, and preferably attached to the compressor or compressor base so it will vibrate with the compressor. If it is attached to a rigid surface, the compressor vibrations may cause discharge line or joint failures. The oil separator should be located above the compressor oil level and the return line connected to the crankcase so that it is free draining. This provides for oil return by gravity during shut-down, resulting in an empty separator at start-up when the separator action is most important. The separator acts as a trap for the collection of Freon and oil draining from the discharge line during shut-down, and returns it to the crankcase rather than allowing it to collect on the head valves. Usually on a start-up, and particularly with flooded or semi-flooded evaporators, a certain amount of liquid Freon is handled by the compressor and this increases the amount of oil pumped by the compressor. This condition lasts only a short while, but to prevent pumping too much oil from the crankcase, maximum separator efficiency must be available at start-up. Fig. 23 illustrates these points.

Fig. 23. Oil separator installation.



Construction

The designer of a refrigerant piping system must also specify the materials to be used and how they are to be installed. The following information will assist in writing proper specifications.

Material. Refrigerant lines may be either copper tube or seamless steel pipe.

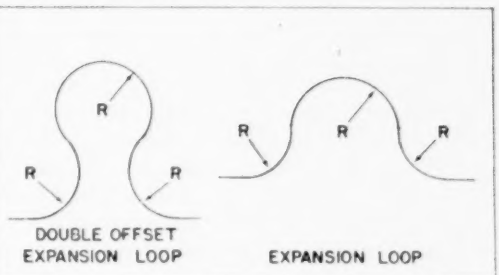
Copper Tube. Commercial hard drawn copper tube is suitable for refrigerant lines. Of the various wall thicknesses available, only type *K* or *L* type should be used. The heavier wall type *K* is particularly recommended because of its greater strength. Soft copper tube of type *K* or *L* wall thickness is also suitable and should be used where ease of bending or forming is required. To conform to standard practice, copper tube orders should specify type and O.D. dimension, although I.D. or nominal dimension and wall thickness may be given. To minimize the amount of cleaning required, it is also advisable to specify deoxidized tube with sealed ends.

Fittings for Copper Tube. The required elbows, tees, couplings, reducers, plugs and miscellaneous fittings may be either forged brass or wrought copper solder type fittings. Flare type compression fittings are adaptable to connections for smaller size soft tube such as is used on gage and control lines. These fittings are ordered by O.D. size, specifying male or female connection. Cast fittings are generally not as satisfactory for refrigerant applications because they may be porous and may crack if overheated. They may be used, however, if well tinned inside and out, before assembly. Do not attempt to braze tinned fittings as the high temperatures required for brazing will cause the solder to melt, run off, and collect inside the tube in the form of slugs. Use only soft solder and be particularly careful not to overheat the fitting.

Steel Pipe. Steel pipe is gaining in acceptance as a piping material for air conditioning and refrigeration installations and is quite satisfactory if applied and installed correctly. Particularly, it must be thoroughly

TABLE 3—LENGTH OF PIPE REQUIRED TO PROVIDE AN EXPANSION LOOP

Nominal Pipe Size, Inches	RADIUS-R, INCHES FOR TRAVEL OF EXPANSION LOOP PIPE, INCHES								
	½	1	1½	2	2½	3	4	5	6
¾	10	15	19	22	25	27	30	34	38
1	11	16	20	24	27	29	33	38	42
1¼	11	17	21	26	29	32	36	42	47
1½	12	18	23	28	31	35	39	46	51
2	14	20	25	31	34	38	44	51	57
2½	16	22	27	32	37	42	47	56	62
3	18	24	30	34	39	45	53	60	67
4	20	28	34	39	44	48	58	66	75
5	22	31	39	44	49	54	62	70	78
6	24	34	42	48	54	59	68	76	83



Bends to left of heavy line can be made from 20 ft or less of pipe. All bends made from type K pipe. Bends requiring more than 20 ft pipe are made in sections and assembled with couplings or flanges.

TABLE 4—MAXIMUM SPACING BETWEEN PIPE SUPPORTS FOR COPPER OR STEEL PIPE

Nom. Pipe Size, Ins.	1	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
Maximum Span, Ft	7	9	10	11	12	13	14	16	17	19	22	23	25	27	28	30	32

cleaned and precautions taken to minimize the formation of scale during welding. A mild carbon grade of seamless steel pipe conforming to specification A-106 of the American Society of Testing Materials is recommended. Pipe should be Grade-A with wall thickness complying with Schedule 40 formulated by the American Standards Association. Nominal size, grade and schedule number should be specified when ordering steel pipe. Fittings for steel pipe, forged, seamless steel, butt welding type fittings conforming to ASTM specifications A-106 are recommended. They should meet ASA Grade-A, Schedule 40, standards.

Various types and sizes of fittings may be fabricated on the job by making mitered cuts in copper tubing or steel pipe and brazing or welding the cut ends together. Also, various types of joints can be fabricated in copper tubing by swedging and brazing. However, it is advisable to use standard wrought or forged fittings.

Expansion

In order to obtain adequate flexibility to absorb changes in length due to linear expansion and contraction of piping with temperature change, long, straight runs should have U-bends or other conventional expansion loops and flexible hangers. Table 3 gives basic data necessary for the fabrication of such loops with copper tube. For steel pipe the same general loop dimensions as shown for a double offset bend may be employed, but the loop fabricated of straight pipe and ell fittings. This takes full advantage of the transverse flexibility of the straight pipe lengths to provide adequately for expansion or contraction. Expansion loops must be supported in a manner that will allow the expansion loop to take the strain, and should be in the horizontal plane to prevent the formation of a trap. It is generally advisable to pre-stress the piping when it is anchored so that it will not be stressed when under normal operation conditions.

Support

On horizontal pipe runs, supports should be substantial enough to prevent high bending stresses in the pipe. Table 4 gives hanger spacing dimensions. Rod-type hangers, perforated metal strips or wall brackets which are all commercially available are satisfactory and simple means of support. On long horizontal runs, flexible hangers should be used to permit the free expansion and contraction of the piping. Spring hangers, roll hangers or pipe roll stands are typical supports designed for this purpose.

The weight of vertical piping may be either supported with riser clamps bearing on structural members of the building, or by a platform at the bottom of the riser. A horizontal pipe run connected to a vertical riser must be well supported so that its additional weight is not added to the vertical riser.

Supports should be strong enough to support any load added by thermal expansion or contraction of the pipe so that stresses will not be placed on the equipment to which the piping is connected. It is better to support piping from a rigid surface, with some form of vibration isolation between pipe and support where the surface is such that objectionable vibration may be transmitted through the structure. The anchoring of pipe in a flimsy manner or to an unsubstantial surface introduces the possibility of a resonant effect setting up vibrations of large amplitude which could result in damage to the pipe itself. Steel or concrete is usually a substantial surface to anchor pipe to, and a well braced wood surface may also be satisfactory.

It is advisable when using a clamp or roll type hanger to isolate the pipe from the clamp or roll with rubber, gasket material, or some other non-deteriorating nonmetallic material to prevent electrolysis and chafing of the pipe both of which could eventually cause leaks.

Vibration

No matter how well the compressor is isolated or supported, some noise and vibration will be transmitted through the piping. A great deal of noise and vibration transmission can be minimized by proper design and installation of suitable supports and isolation.

When the compressor is supported by vibration absorbing mounts, refrigerant lines should not be anchored rigidly at the unit, but at some distance away so a length of pipe can absorb the motion without being overstressed. Similarly, an accessory such as an oil separator should not be mounted securely to the floor and close coupled to a flexibly mounted compressor, but should be mounted on the compressor itself. Piping flexibility may be obtained by using spring type hangers, by including loops in the lines, or by installing a length of flexible tubing.

It is a mistake to anchor pipe in a flimsy manner as a means of reducing vibration transmission. Such inadequate support is apt to set up resonant vibrations or the motion permitted may cause cracking or chafing of the pipe. Instead, the pipe support should be mounted on a vibration absorbing base designed to provide adequate support yet prevent vibration transmission.

Flexible hose is often used as a means of reducing vibration transmission along piping. While this method is effective with small size pipe, to be effective with larger diameters, long lengths of hose are required which may make it uneconomical. Also, the larger sizes must be designed to withstand the larger forces of internal pressure and are less flexible. In using flexible tubing to compensate for compressor motions, install a length of flexible hose at right angles to the direction of compressor motion; horizontally if the motion is vertical, vertical if the motion is horizontal; and both horizontal and vertical if the motion is both vertical and horizontal. If flexible hose is used, it should be of the best grade available, since this is a weak point in a refrigerant system and a potential trouble source.

Check of Air Conditioning Noises in Television Studios

T. W. REYNOLDS

Practical guidance for engineers who desire to eliminate noise in television studios that result from the air conditioning system. Such noise in television studios must be carefully avoided in order to prevent factors that interfere with the quality of broadcasts.

LIGHT, occupancy and humidity loads of radio and television shows vary from one show to another and so does the physical design of a studio. Also, the types of shows may differ. For example, a show may feature a kitchen or laboratory where some demonstration or experiment is producing odor as well as humidity, both of which must be removed. However, the major problem in television studios is the noise factor. Sources of this noise may be the blower and motor, the mechanical refrigeration equipment, air flowing through the duct system, and the air diffusing outlets.

Although the air outlet is about the only visible thing in the air conditioning system, and is the final source of noise from it, other sound sources play a primary part in the total sound energy delivered to the conditioned space.

Equipment Noises

Fan, motor and refrigeration equipment should be set on shock absorbers to prevent the vibration which might otherwise travel through the duct system into the studio and result in noise. For heavy equipment, the foundation should be separate from the building foundation with reinforcement for the equipment base extended all the way down to the ground and at no point in contact with the binding.

Should the fan wheel create turbulent air flow in the fan discharge side, it will be necessary to add turning vanes in the duct elbows and these vanes should be felt padded. The vanes with padding will eliminate any rushing air noise due to turbulent or one sided air flow.

Both motor and fan should be properly lined up, the fan wheel checked for proper direction of running, and canvas joints installed on the fan outlet. A belt drive is preferable, as such arrangement is easier to line up and noise can not travel from the motor to the fan.

Noises in the Duct System

Branch ducts need sufficient hangers for stability. Ducts to air diffusers should have an air velocity at least 100 fpm less than the corresponding neck velocity of the air diffusing outlet. Other noises may be caused by lack of (1) sound absorbing lining in the ducts and felt lining on the dampers, and (2) sound insulation on the outside of the ducts. Such treatment prevents noise travelling from one studio to the other. Ducts acoustically lined should be increased in area by the amount of area taken up by the lining.

Ducts passing through walls should have additional insulation at such points to avoid picking up noises that emanate from the wall. An elbow branching off too close to the fan outlet will require sound treatment by an acoustical lining or a sound trap.

Branch ducts are often found set loosely and installed with an insufficient number of hangers. Loose dampers and sharp edges in the ducts will cause noise. One must remember that ducts need elbows of proper sweep, or the addition of turning vanes to prevent turbulence and one sided air flow.

Where ducts are necessarily run above a studio, they should be mounted on hangers of floating construction. Separate ducts, both supply and return, run from each room to the air conditioning unit will prevent noise travel from one studio to the other.

High heat loads require a large number of air changes, so when air changes from the air diffusers are excessive, it will be necessary to select a type that will be quiet when handling large volumes of air. Generally, this becomes necessary when air changes exceed 12 per hour.

Air Velocities

Air velocities through the neck of air diffusers should not be over 700 to 900 fpm, the higher velocity being used with greater ceiling height. Sound of course, travels in waves which diminish in intensity as they move away from the source of noise. Therefore an air diffuser located at the ceiling will be quieter than one on the wall, even though the wall outlet is but one or two feet below the ceiling.

The joint between the duct and air diffusers should be flexible and the air diffusers mounted tight against the duct to prevent air leakages as these create noise. Equalizing deflectors in the neck of the air diffusers will equalize the air flow for quiet distribution, but a turbulent flow in the duct, especially when above the neck of the air diffuser, will require additional turning vanes to even out the air flow. Padding of the vanes and the blades of the equalizing dampers will absorb noise.

What Would You Do?

Replies to engineering and operating problems of interest to the industrial plant engineer

Conducted by
NATHAN N. WOLPERT
Associate Editor

HEATING industrial plants is at times difficult and the solution may be found in spot heating. This month's discussion concerns the heating of a building used in part for large part assembly and for machine operations where a spot heating installation has been suggested.

Perhaps you have an industrial plant problem that you would like to see discussed in this department, or you may have some comments that you would like to add to the discussion of a problem scheduled for a future issue. In either case, your letter to the Editor would be welcome.

This Month's Problem

One of our factory buildings is long and narrow. Part of it is used for machine operations and part for large part assembly. Some dissatisfaction has been expressed with the present heating and the installation of elevated spot unit heaters has been suggested. Are there any rules for the good installation of such heaters?

A spot heating system is usually employed to supply heat for the operator of a solitary machine or a localized process within a much larger unheated building. Both vertical and horizontal discharge unit heaters may be used, the decision being governed by the presence of physical obstructions, the location of available steam facilities and other factors.

It is essential to drastically restrict the mounting height of the unit. Heat losses, as they are usually considered in a normal heating problem, are meaningless in a spot heating application.

Since the objective is to blanket the prescribed space with a constant stream of warm air, the volume of this imaginary three dimensional space that is to be heated must be kept as low as possible. As height is as important as the other dimensions, mounting height of the spot heater must be limited. The heat throw or permissible mounting height of any unit heater will probably be less than half of the distance suggested by the unit heater manufacturer for normal heating installations.

In cases where piping problems require the unit to be placed at an excessive height, it is sometimes feasible to provide a straight duct from the discharge of a vertical delivery unit to a more reasonable height. An adjustable deflector can be provided at the outlet end of the duct, if considered advisable.

Dimensions of the space to be heated must be determined very closely. Partially confining walls, such as low partitions are extremely helpful since they minimize the tendency of cold drafts to flow along the floor from the adjacent sections where the temperature is lower. Also of value is a ceiling or canopy, partial or complete, and as low as possible.

Where retaining walls are provided, length and width of the space to be spot heated may be considered as this walled-in space; where there is a canopy, then the height may be taken as the distance from floor to canopy. Where such a ceiling is not practical, then the height may be taken as mounting height plus 50% or at least 6 ft unless the resulting figure exceeds the actual ceiling height of the building in which case the latter will apply. Where retaining walls are not provided, then the dimensions are the length (or width) of the space to be heated plus 10 ft. The following formula may be used for determining the air delivery:

$$CFM = \frac{Vol \times AC}{60}$$

where CFM = air delivery, capacity of unit heater in cubic feet per minute (catalogue rating)

Vol = volume of space to be heated

AC = number of air changes per hour

60 = minutes per hour

The unit heater selected should provide from 15 to 30 air changes per hour. Judgment must be used and 30 air changes should be considered (1) where the building is so poorly constructed that it is little more than a windbreak; (2) for areas of less than 250 sq ft of floor area; (3) for areas near often-opened doors; (4) for larger areas exposed on all four sides, or which are long and narrow or otherwise shaped so as to present a comparatively large perimeter for the escape of the heated air.

Problems for Coming Issues

April Issue

A 3-story building is to have a standpipe system installed. Is it possible, as this is only a 3-story building, to have the system served directly from the street main without a roof tank? How would the service line be connected in the basement?

May Issue

In a storage tank for heavy fuel oil, what arrangement would you suggest for heating the oil feed line to the burner to promote good oil flow? Should the heater be installed inside or outside the tank?

The final air temperature under these design conditions should be the entering air temperature plus about 65F but not more than 90F. This requirement may dictate the use of low outlet temperature units, particularly if high pressure steam is used.

When overhead horizontal delivery units are used at limited heights of not more than 7 or 9 ft, outlet velocities should range from 850 to 900 fpm for units of about 1,300 cfm, and 1,200 or 1,400 fpm for larger units of about 4,000 cfm. When vertical delivery units are used, velocities should range from 950 or 1,000 fpm for 1,500 units to around 1,900 fpm for 8,000 cfm units. Unavoidable errors in judgment may often be minimized or corrected by the use of an adjustable diffuser if an error was made in selecting a unit with too much velocity. Little can be done if units of too low velocity are selected.

In general, horizontal delivery units should never be mounted more than 7 to 9 ft high unless capacity of units exceed 5,500 cfm and velocity is greater than 1,700 fpm. Vertical delivery units should be limited in mounting to a maximum of 10 ft unless they exceed about 6,000 cfm delivery in which case they may even be placed as high as 20 ft.

Wherever possible, use recirculating ducts with either horizontal or vertical delivery units to draw the inlet air from the floor area of the heated space. In this way it will be possible to use a design entering temperature at least 20F above the normal room temperature of the surrounding unheated space, and it will reduce the design number of air changes per hour by 25%. Ductwork, in such cases, should be about the full size of the unit heater inlet, with a minimum of bends and other restrictions. Inlet openings instead of grilles should be used to minimize the static loss.

Another refinement, often practical, is the use of unit heaters discharging horizontally just above the floor into the space to be heated. If this is done, lower outlet velocities are desirable and several small unit heaters should be used in preference to one large unit.

H. E. Smith
Shultz & James, Inc.
Richmond, Va.

Study Made of Underground Corrosion of Galvanized Steel

A study of underground corrosion of hot-dipped galvanized steel pipe, completed by the National Bureau of Standards, confirm previous NBS work in showing that galvanized steel having three ounces of zinc per square foot of exposed surface is highly resistant to corrosion in many soils which are, in general, very corrosive to bare steel.

For the Bureau's study, short lengths of both galvanized and uncoated steel pipe, and also plates of zinc, were buried at 15 test sites for periods up to 13 years. Located in widely separated parts of the United States, the test sites represented a wide range of soil properties. After each of five periods of exposure, a set of specimens of each material was removed and returned to the NBS laboratories. After removal of the corrosion products, determinations were made of loss in weight, depth of the deepest pits, and the percentage of area of the galvanized specimens on which coating remained.

Thickness of Coating

Although the nominal weight of the zinc on all the coated specimens was three ounces per square foot, the actual thickness varied over a wide range. This was shown by a large number of thickness measurements made by a magnetic method, using unexposed samples of pipe from the same lot as the buried specimens. Additional determinations by an electrolytic stripping method showed that a large part of the zinc that was applied to the steel pipe was converted into alloys of zinc and iron.

The zinc coatings provided good protection in most of the soils. In one soil in which bare steel pipe was perforated by corrosion after exposure for only a few years, the coating on the galvanized specimens remained perfectly continuous throughout the entire 13-year period. In only two of the 15 soils, both organic, was the zinc coating of negligible protective value.

An interesting finding of this study was the high corrosion resistance that the galvanized specimens continued to show in most of the soils after the outer zinc coating, and even after the zinc-iron alloy layer, had entirely corroded away. This continuing protection is tentatively attributed to an inorganic coating, probably silicious, believed to have been deposited by galvanic action between the outer zinc coating and the underlying steel or alloy layer. This tentative explanation is based in part on unpublished studies which indicate that the zinc-iron alloy layer does not protect steel sacrificially (cathodically), and that the alloy is no more resistant than steel to soil corrosion.

Analysis of Finding

Analysis of the data obtained in the course of the two NBS field studies shows that the minimum weight of zinc coating required to protect steel for a minimum of 10 years depends on the nature of the soil environment. In these studies a 2-ounce coating gave sufficient protection in inorganic oxidizing soils, but for inorganic moderately reducing soils, a 3-ounce coating was required. Highly reducing soils, both organic and inorganic, require coatings heavier than 3-ounces per square foot.

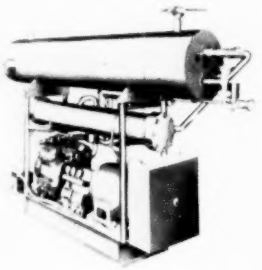
In order to obtain maximum life from galvanized pipe in practice, it is necessary either to construct the entire piping system of galvanized pipe or else to electrically insulate the galvanized sections from pipe of other metals. Otherwise, the zinc coating will be removed by galvanic action.

NEWS OF EQUIPMENT AND MATERIALS

Use the prepaid postcard opposite page 131 for securing additional information on items described in this department.

Packaged Water Chiller

A new cold generator packaged water chiller, designed for medium-sized air conditioning systems, is announced by The Trane Co., La Crosse, Wisc.



The cold generator was designed to provide a single-unit source of large quantities of cold water for air conditioning and refrigeration systems requiring between 10 and 50 tons of cooling. This self-contained unit is suitable for refrigeration installations for air conditioning systems in office buildings, plants, theatres, hotels, auditoriums, and department stores.

Installation savings are accomplished by combining compressor, condenser, liquid cooler, controls, motor and accessories in a single factory-assembled and tested unit that requires only plumbing and electrical connections to put them into service.

A multi-step reciprocating compressor, which is the heart of the unit, automatically adjusts power and water consumption to the demand for cooling in regular stages. The compressor's coated valves, lubrication system, shaft seal and other features are all designed to minimize maintenance and servicing.

The cold generator will be made in 6 sizes, with capacities from approximately 10 to 50 tons of refrigeration. It will be used in both air conditioning installations and industrial processes.

More Information? Circle Item 1 on postcard, page 131

Diffuser for Year Round Systems

The model VH has been added to the line of Flexiflo air diffusers made by Universal Diffuser Corp., New York, N. Y. This diffuser has push-pull control to provide a simple means of changing the characteristics of the diffusers from summer cooling to winter heating.

The central controlling rod is actuated by two springs and has two adjusting collars on it. The springs have a snap action similar to that of an electric light switch; that is, they will push the blades up or down and keep them firmly in place. In order to adjust the position of these blades the collars are fastened at the required intervals on the rod. Once these collars are adjusted it is simple for the homeowner to change over from winter heating to summer cooling by simply pushing or pulling the central knob.

More Information? Circle Item 2 on postcard, page 131

Oil Fired Boiler-Burner Units

The Gulf Stream line of oil fired boiler-burners has been introduced by Aldrich Co., Wyoming, Ill., a subsidiary of Breeze Corporations, Inc. The boilers, all steel, are available in five sizes with capacities ranging from 440 to 1120 square feet of water radiation.

Multiple flue tube construction, with special baffles installed inside each tube to force the hot gases into scrubbing contact with the tube walls, permits maximum heat extraction and quick and efficient transfer of heat to the boiler water.

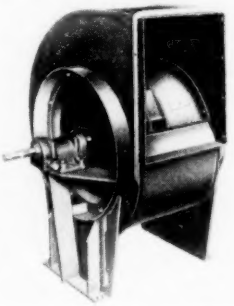
The company's tankless hot water coil provides quick, low-cost hot water, regardless of the time or day or the season. A quick-acting control reacts immediately to a drop in boiler water temperature and starts the burner. The circular design coil is readily removable through top of boiler. Tankless hot water coils are optional equipment.

More Information? Circle Item 3 on postcard, page 131

Two Lines of Fan Equipment

Two new lines of fan equipment, the V-Belt Ready units and the Type NH fans, are placed on the market by Clarage Fan Co., Kalamazoo, Mich.

The line of NH fans, which are designed with a non-overloading power characteristic, are available in 23 sizes with capacities up to 650,000 cfm. Sizes 30 through 73 are equipped with universal discharge, making the fans readily adjustable in the field to any of eight directions of air discharge. Their housing consists of two side sheets and a scroll sheet joined by means of a standing seam, the design being to protect against air leakage yet providing rigidity.



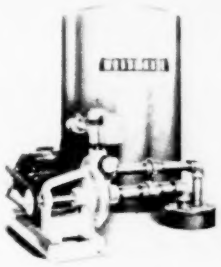
Sizes 80½ through 265 are built with any standard discharge and either rotation as specified. Their housing consists of two reinforced side sheets bolted to the scroll sheet.

The V-belt driven Ready units are complete ventilating sets of universal application. They are available to handle any volume of air from 100 to 12,000 cfm and come in three types of construction: standard units for applications where equipment is to be installed indoors; units equipped with outdoor covers for installations exposed to the weather or for installations indoors if complete enclosure is desired; and units equipped with drive guards for all sizes. All units are designed so that the entire drive is within the frame of the unit.

More Information? Circle Item 4 on postcard, page 131

Ejector Pump is Packaged Unit

A new ejector type water system, designated BeP, which incorporates a V-belt drive, is manufactured by Woodmanse Mfg. Co., Freeport, Ill.



Designed as a one pump package which will operate on shallow or deep wells where the water stands within 100 feet, the unit is equipped with a standard 1725 rpm motor in any size from ¼ to 1 hp. In the event of motor or electrical failure, the motor can be easily replaced by any other conventional motor or the unit may be driven by tractor or gas engine power.

Each unit includes a jet package with brass nozzle tips and venturi throat inserts for any combination motor size and pumping depth, with pumping capacities ranging up to 1250 gph.

The unit retails for $64 and includes pump, ejector package, pressure switch, pressure gage, motor and pump pulley, V belt, automatic pressure control, and pump and motor base.

More Information? Circle Item 5 on postcard, page 131

Bench Warms Benchwarmers

A radiant-heated bench for keeping football players warm while seated on the sidelines during a game, is developed by Lee-Don, Inc., Pittsburgh, Pa., using product, Heatcrete, and built by Perlite Manufacturing Co., Carnegie, Pa.

The heated slabs are made in sandwich form with concrete used for insulation on the bottom half, and electrical resistance wire imbedded in the upper half which is made of Heatcrete for high thermal conductivity. The benches are designed to add to players' comfort and reduce injuries by sending them into play more warmed up.

These heated slabs were built to dramatize the company's proposal to protect the investment in northern stadiums with a snow-melting surface of its product to eliminate frost damage and add to spectators' comfort.

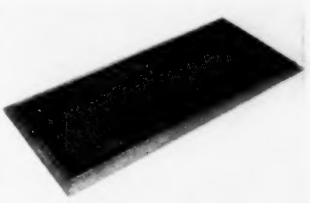
The high strength, as well as high heat conductivity developed by the product make it possible to use only a thin heating surface panel in connection with electrical resistance wire to cover an existing structure.

The company also points out that it is perfectly feasible to change an existing stadium into an all weather field house through the use of hot water radiant heating and portable or sliding side walls, since radiant heat waves warm the body but do not warm the air.

More Information? Circle Item 6 on postcard, page 131

500 Watt Electric Ceiling Panel

The No. 500 electric glass radiant heat panel is a new product of Electriglas Corp., Bergenfield, N. J. It has a capacity of 500 watts, or 1707 Btu per hour. This ceiling panel is insulated and backed with reflective aluminum so that all of the heat is beamed downwards into the room where it is needed and none is wasted heating the ceiling. The panel is installed on the ceiling along the outside perimeter of a room.



The Electriglas panel is practically invisible and blends with the structural lines of a house. Being mounted in the ceiling, it does not occupy floor space nor interfere with furniture or draperies. It is simple to install and can be installed in one operation in a few minutes per panel at little expense.

More Information? Circle Item 7 on postcard, page 131

Stops Radiant Heat Leaks

A new product that is specifically formulated for stopping and sealing leaks in radiant heating systems is announced by Radiator Specialty Co., Charlotte, N. C.

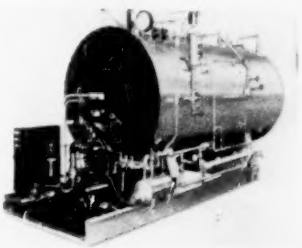
The new product, known as Type R-H Boiler Solder Seal is especially recommended for use on new installations to seal the entire system and prevent any leaks. This is its biggest advantage because leaks could cause damage in ceilngs, walls and floors where most radiant heating systems are installed.

The new product will seal leaks in copper, cast iron or other types of systems. It will not clog heating systems and seals with a rugged, metallic bond.

More Information? Circle Item 8 on postcard, page 131

Boilers Fired by Gas or Oil

Combination gas- and/or oil-fired boilers, which can operate on gas with the oil burner in place yet not requiring mechanical or electrical change to switch between gas and oil, are introduced by Cleaver-Brooks Co., Milwaukee, Wis.



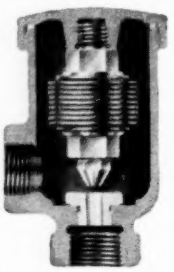
Flipping a selector switch on the control panel, to either gas or oil, sets the proper circuit into action. Turning the fuel supply valves completes the entire changeover in 10 seconds or less.

This development makes the unit suitable for gas users in areas where local requirements demand quick changeover. This fuel flexibility can be an important factor in determining overall operating economy.

More Information? Circle Item 9 on postcard, page 131

Industrial Steam Trap

The addition of the new Type D thermostatic bellows industrial steam trap to its line is announced by W. H. Nicholson and Co. Wilkes-Barre, Pa.



This trap is smaller in size, capacity, and price than other types made by the company, and is designed for installations of smaller requirements.

It embodies several improved design features, including generous sized hexagon shanks to accommodate standard wrenches, for installing or removing bellows and valve. This eliminates strain on the bellows element.

An internal guide rod and tube for maintaining alignment of valve and seat, and a removable hardened stainless steel valve and seat are also featured.

Made of bronze construction, the trap comes in sizes ¼, ⅜, ½, and ¾ inch in angle type only. They are designed for pressures ranging from vacuum to 200 psi.

Bulletin No. 351, a 2-page folder which describes the new trap, is available.

More Information? Circle Item 10 on postcard, page 131

Gas Pilot Pressure Regulator

The model RV-10-⅛ inch Maxitrol pilot pressure regulator is introduced by Detroit Regulator Co., Detroit, Mich. It was designed for use in controlling standing pilots on domestic gas fired heating appliances.

The regulator features some novel design arrangements. The top cover is fastened to the main body casting by a crimping ring. It cannot be disassembled, and is therefore tamper proof. It is constructed with a synthetic rubber seat which insures accurate regulation at extremely low flow rates. The regulator is extremely small in size and has a diameter only slightly larger than that of a silver dollar. It can therefore be assembled and installed in extremely limited space.

More Information? Circle Item 11 on postcard, page 131

Pressure Controls Redesigned

The new 101P sensitive static pressure controls employing a silicone impregnated glass cloth diaphragm, allowing operation at high or low temperatures over long periods of time, designed to replace its original 101 controls are introduced by the Henry G. Dietz Co., Long Island City, N. Y.

The controls are for application on very low pressures where regulation is required in inches of water. It has applications in air conditioning, heating, and industry, where it is necessary that a circuit be controlled from the exhaust side of a fan, and, in event of fan failure, auxiliary equipment will be shut down.

Units are of small size, obtainable in standard ratings ranging from 0 to 20 inches of water pressure with range adjustment and with fixed differentials from .2 to 2 inches water pressure. Installation is simple, requiring only one hole to mount on a vertical wall or duct.

More Information? Circle Item 12 on postcard, page 131

Pump Unit Entirely Submersible

Pumping units, which are entirely submersible in water, are available in capacities ranging from 225 to 1500 gph with vertical distance to lowest level in wells ranging from 40 to 400 feet from The Deming Co., Salem, Ohio.

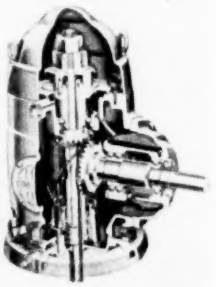
Moving parts of pump and motor are water cooled and water lubricated, so that there is no danger of contaminating water supply with lubricants. The motor is designed to operate in water. Windings are permanently enclosed in stainless steel case. The cable is connected to a watertight fitting. Motor relay and capacitor are located in a control box above ground for easy accessibility.

Storage tank and control may be located away from well, if desired, and service line placed below ground to eliminate a pit or pump house. As the pumping unit with its motor is located down in the well, danger of freezing or tampering with the unit is eliminated.

More Information? Circle Item 13 on postcard, page 131

Gear Drive for Vertical Pumps

A new right angle gear drive, permitting the use of gas, diesel, or gasoline engine power for operating deep well pumps in locations where electricity is not available or where gas can be economically used for power, has been developed by U. S. Electrical Motors Inc., Los Angeles, Calif.



This new drive is universally adaptable to any vertical pump and is suitable for construction operations where water is to be lifted from a source distant from power lines.

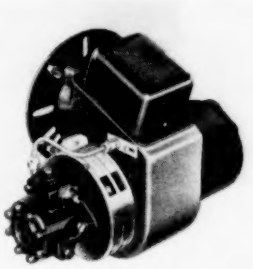
Called the Holloshaft, it provides constant cycling of oil which can be visually observed by incorporation of a window and a flush-style oil gage. The operator can view the flow of oil from the exterior. The thrust bearing set in the top is easily accessible and can be removed without disturbing the hollow shaft or gears.

A special dual-contact shaft seal prevents escape of lubricant and entrance of dust or moisture shaftwise. To prevent the pump from back-spinning when the engine stops, choice of two types of automatic, built-in backstops are provided. Tandem mounting of thrust bearings can be arranged to give higher thrust ratings for extra deep pump settings or where large water volume is delivered.

More Information? Circle Item 14 on postcard, page 131

Oil Burner for Replacements

An oil burner unit, designed for a wide range of applications as a replacement burner in package heating systems, is manufactured by Wayne Home Equipment Co., Inc., Fort Wayne, Ind.



The 0.6 to 3.0 gph range is claimed to reduce inventories by supplying 95% of all residential requirements for package heating systems or conversion installation.

Other features include multiple air-adjusting bands; a no-drip nozzle adapter for sharp oil cutoff to eliminate smoke and carboning; cast aluminum fan housing to maintain parts alignment; swing-away transformer; built-in junction box and standardized electrical components and fuel unit.

A 4-in-1 air tube gun assembly plate is segmented for break-away to measure air needed for nozzle ratings. Universal mountings are included in the unit design.

More Information? Circle Item 15 on postcard, page 131

Baseboard Hot Water Heating

Two new model baseboard heating units, designed for use in its Tru-Perimeter forced hot water heating system, are announced by Warren Webster and Co., Camden, N. J.

Designated Standard baseboard heating (above) one model features a rectangular heating element 2 by 2¾ inches in area. This unit projects 2⅜ inches from the wall, and the height to the top of the moulding is 8¾ inches.

For installations requiring larger units, Hi-Cap baseboard heating (below) has a rectangular element sized 2¾ inches by 4 inches. It projects 3⅜ inches from the wall and the top of the moulding is 11⅞ inches from the floor.

The new units are furnished for installation with finned tube heating elements in the following lengths: 1, 1½, 2, 2½, 3, 3½, 4, 5, and 6 feet. Each element has one belled

end and one straight end, eliminating the need for a sweat coupling to connect two lengths.

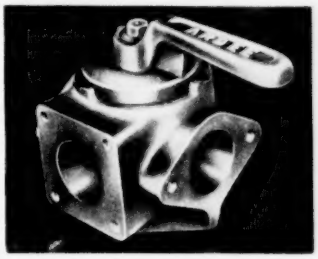
Also furnished are an 8 foot long enclosure consisting of back, front, bracket, and trim; sheet metal screws for fastening trim to enclosure; and a ¾ inch fitting with a ⅛ inch pipe plug for installation at drain points. A damper unit consisting of damper, damper operator assembly, and necessary fastening parts is optional.

Other optional material, supplied where necessary, includes a return header assembly, separate balance and purge valves, circulator, expansion tank, airtrol tank fitting and boiler fitting, flow control valve, pressure reducing and relief valve, floor cover plates, 3-way valve package units, and the firm's Walvector units.

More Information? Circle Item 16 on postcard, page 131

125 Psi Recirculating Valve

A recirculating valve that may be used for any stream dividing application of gases, air, salt water, oil and mild chemicals to 125 psi is in production by Ardee Mfg. Co., Los Angeles, Calif.



The design incorporates a combination of plug valve principles and O-ring sealing. It is claimed that a positive leakproof condition is obtained and that handle loads and internal wear are reduced to a minimum by the use of an externally adjustable spring seating control featuring multiple ball pressure contact against a hardened wear ring.

Manufacturer reports recent tests indicate minimum pressure drop and full pipe orifice flow characteristics in 2 inch size now being produced.

Valve is available in cast aluminum, steel or Navy bronze. Bronze and steel valves are cadmium plated throughout. Flange connections are available for either male or female thread adaptation.

More Information? Circle Item 17 on postcard, page 131

Damper Hardware in Parts Kit

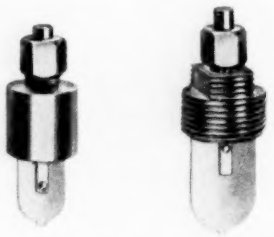
The Duro Blade Kit, consisting of several specially designed precision-engineered hardware parts designed to simplify damper assembly, is distributed by Duro-Dyne Corp., Hempstead, N. Y.

One of the features of the kit is the automatic aligning feature of the bracket which is self-centering. Other features include the self-oiling bushings which tap-fit into the frame; parts which are attached to the blade can be screwed, bolted, riveted, welded or spotwelded as individual shop methods dictate; and brackets fit all blades three inches or wider. All parts are of corrosion resistant materials, capable of performance on the heaviest dampers. They operate on either parallel or opposed action dampers.

More Information? Circle Item 18 on postcard, page 131

Adapter Makes Balancing Fitting

A line of balancing valve adapter units is introduced by Maid-O-Mist, Inc., Chicago, Ill. For hot water systems, they enable the contractor to make his own balancing fittings, eliminating expensive stocks. These units make any copper, bronze or cast iron tee a balancing valve.



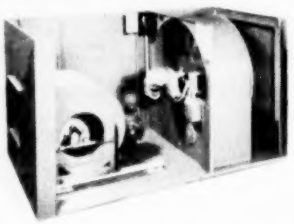
Designed to regulate the flow of hot water through radiators, convectors, baseboard panels, radiant coils, return mains and branches, these adapter units may be inserted in the side outlet or in the run of any tee of the same pipe size to complete either a straightway or angle balancing valve. The slotted shutter can be moved up or down on the valve stem to compensate for any manufacturers difference in the height of the tee sleeve. Simple balancing adjustment is made through the convenient screw driver slot which may be locked in place by tightening the packing nut.

The No. 14 adapter (left) is readily soldered or sweat-fitted into a copper or bronze tee. The No. 15 adapter (right) is threaded for use on cast iron tees only. The former is for use with $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$ and 1 inch nominal copper or bronze pipe size; the latter is for use with $\frac{1}{2}$, $\frac{3}{4}$, 1 and $1\frac{1}{4}$ inch cast iron tees.

More Information? Circle Item 19 on postcard, page 131

Cooler Has Added Features

Several new features have been incorporated in the Far-Air package cooler for 1953, including filters, cooler, blower and motor, and automatic flushing controls, according to Farr Co., Los Angeles, Calif. Thermostat control can be incorporated.



New features in the unit include an improved chemical brick in the water tank to prevent accumulation of salts and minerals on the rotor, and perfection of a system for automatic, periodic draining and flushing of the water tank to remove accumulations of minerals and organic material and maintain a clean unit with a minimum of attention.

The chemical brick softens the water used in humidifying and prevents minerals from being deposited on the Golden Rotor, heart of the package cooler's action. The rotor revolves at $1\frac{1}{2}$ rpm through water, constantly presenting a uniformly wetted bronze mesh surface to the air stream. Because of its slow speed there are no flying droplets of water to dampen surrounding areas. Regular flushing and draining also prevents minerals, fungus and other organic material from creating objectionable odors.

Introduced as a package unit two years ago, it is designed to both humidify and cool dwellings and business structures. The package cooler can handle any cfm requirement because it can be installed singly or in multiple units. Three models, in 2500, 4000 and 6000 cfm capacities, are available and can be located in basements, attics or outside the building. No special installation materials or skilled labor is required.

More Information? Circle Item 20 on postcard, page 131

Flexible Duct Connectors

A new product shown at the International Heating and Ventilating Exposition in Chicago was Ventglas fabric for flexible duct connections, manufactured by Iden Associates, Chicago, Ill. This product is a special heavy glass fabric, double coated with Neoprene for use in duct connectors, flexible connections where unusual chemical or heat conditions exist. It has high heat resistance.

When subjected to unusually high temperatures over a period of time, the Neoprene may crack off, but the glass fabric will remain until its melting point is reached. It has excellent resistance to acids, alkalis, grease, and gasoline. It is also waterproof, fire-resistant, mildew and weather resistant.

The product is recommended for installations such as kitchen exhausts as it will not absorb greases.

More Information? Circle Item 21 on postcard, page 131

Liquid Level Controls; 2 Types

Two new liquid level controls, one for tank or sump applications and the other a side mounting tank float switch, are being produced by Magnetrol Inc., Chicago, Ill.

Model A-100 (illustrated), for tank or sump application, has this new feature. It uses displacers made of porcelain, neoprene, or karbate, depending upon the specific gravity and nature of the liquid to be controlled. These displacers are mounted on a stem and it is their distance apart that determines the amount of liquid travel between switch make and break. Since displacers are solid and heavier than the liquid they control, they sink and thereby overcome the effects of surging or swirling action. With displacers suspended on stainless steel wire, differentials up to 100 feet are possible. Actuating levels are easily adjusted by merely raising or lowering one or both of the displacers.

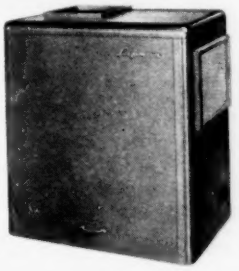
The A-100 is available as a tandem unit with two switches for separate high and low level action in a single unit, and in a variety of trims to suit almost any type of liquid.

Model TF-63 is a tank float switch which mounts on the side of the tank by virtue of a $2\frac{1}{2}$ inch threaded connection. It is suited for high or low level alarm; pump control; and high and low level alarm only. Equipped with a semi-steel body and copper and brass trim, a steel bodied unit with stainless steel trim can be provided in another model of this type, TF-62. If a flanged connection is desired, Model TF-52 is a companion model having the same features with the exception of the mounting Differentials from $\frac{3}{4}$ to $15\frac{1}{2}$ inch are possible, depending upon the length of the float stem.

More Information? Circle Item 22 on postcard, page 131

Convertible Air Conditioners

Air conditioning units that are convertible for use as a duct type conditioner for homes or as a packaged unit for commercial installations are produced by Lipman Refrigeration Div., Yates-American Machine Co., Beloit, Wis. Models are available in 2 and 3 ton capacities.



All basic units can be fitted with either a duct top with necessary outlets for connection to forced warm air ducts for domestic use, or a blower and a plenum top with directional front grille for commercial use. All units have a disposable filter, readily accessible on the side of the cabinet.

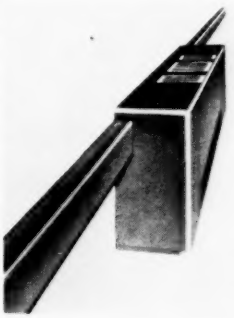
Both units are 36 by 22½ inches in floor area. When equipped with the duct top, they stand 46½ inches high. A plenum top makes their height 64½ inches. An 18 gage steel cabinet, copper tube cooling coil with aluminum fins, and foiled back Fiberglas insulation are provided.

More Information? Circle Item 23 on postcard, page 131

Heating System for Schools

A new concept of school heating and ventilation, featuring a new unit ventilator system, designed to insure equal comfort and health conditions for every pupil in the classroom, is introduced by The Trane Co., La Crosse, Wisc.

The heart of the system is a unit ventilator with duct extensions. The ducts, with grille outlets, extend along the schoolroom's outside wall and under glass areas, at about window-sill height. Treated air from the unit ventilator is sent to the room through the unit grille and through the duct outlets. Thus, the air stream blocks drafts from cold surfaces and distributes heat and ventilation to all parts of the room at all times during the school day.



The system's basic objective is to help solve the problems of maintaining healthful, even temperatures and fresh air in the large daylighted classrooms in contemporary schools as well as in older buildings. For reasons of fuel economy, buildings are generally allowed to cool off at night, and then are heated rapidly in the morning. Shortly after school opens, the classrooms may be heated to overly high and unhealthful temperatures by the radiant heat of the sun and by the large amount of heat given off from the bodies of youngsters.

The new system is designed to cope with these conditions by providing positive method for distributing heat and ventilating air.

Air is drawn into the unit from the room at floor level or from the outside if ventilation is required. Carefully controlled mixtures of room and outside air are also provided when necessary, to maintain proper conditions. Inside the unit, the air or air mixture is filtered and heated to the correct temperature. Then, three centrifugal fans send the conditioned air out into the room, part of the supply leaving through grilles in the top of the unit, part leaving along the wall, through the ducts.

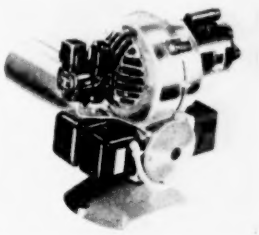
The air stream leaving through the ducts, on both heating and ventilating cycles, accomplishes two functions. It provides properly treated air to all areas of the room, not just to those directly in front of the unit grilles. It provides a constant, positive blockade to cold drafts from wall or window surfaces, whether the unit is supplying heat, ventilation, or both.

Unit ventilators are available with capacities ranging from 500 to 1250 cfm in floor type, semi-recessed, recessed models. Ceiling models are also offered, as well as special cabinets with linoleum tops. Shelving and storage cabinets and supplementary heating units are offered in matching sections, as well as the duct extensions with the units. Duct sections are offered in 5 foot lengths, with 15 foot extensions as maximum recommended overall length.

More Information? Circle Item 24 on postcard, page 131

Large Capacity Oil Burners

Three large capacity oil burners, models XL-10, XL-15 and XL-20, are available from Nu-Way Corp., Rock Island, Ill.



With a fuel burning capacity of 10 gph to 20 gph, the three units are designed for use in apartments, factories and other buildings requiring large capacity oil installations.

These large capacity oil burners feature positive air control and a shielded nozzle.

More Information? Circle Item 25 on postcard, page 131

Pump Installed Away from Sump

The Hi-N-Dry sump pump, designed for installation outside the sump, on the floor, or on a wall bracket entirely removed from the sump location, is introduced by The Gorman-Rupp Co., Mansfield, Ohio.

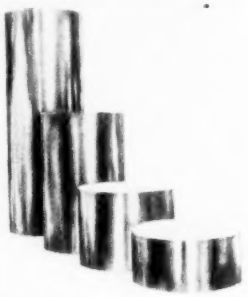
It is not necessary to have the sump pump submerged in the sump with the motor exposed to rising fumes and vapors, nor is there any possibility of accumulated sand, silt or abrasives damaging the unit or causing pump failure.

Readily accessible for ordinary attention, the new pump eliminates much maintenance trouble. Nothing is in the sump but the suction pipe. The only parts subject to wear are the bronze impeller and bronze wear plate, both quickly and easily replaced with ordinary tools. The pump also features automatic priming.

More Information? Circle Item 26 on postcard, page 131

Reflective Insulation in Rolls

A reflective insulation marketed under the name Alfol Asbestos No. 103, designed for the heating industry, is introduced by Reflectal Corp., New York, N. Y.



The material consists of pure aluminum foil permanently bonded, by means of a heat-resistant adhesive, to 1/32 inch calendered asbestos paper. Uses for the product include radiator recess lining, baseboard panel sealing, and medium-high temperature work.

The combination of aluminum foil, which is said to reflect 95% of all radiant heat, and fire-resistant asbestos paper is designed to give the material the thermal efficiency of nearly two inches of aircell asbestos. Completely non-irritating, the material is clean, compact and easy to handle, store, apply. It can be cut with knife, scissors, or any other ordinary cutting tool.

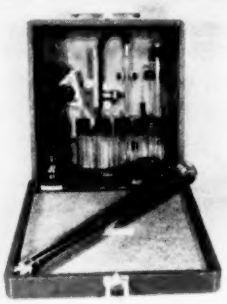
Packaged in handy rolls of 100 lineal feet, it is available in 36, 18, 9 and 6-inch widths. Prices range from $6.13 a roll for 6-inch widths to $19.07 a roll for 36-inch widths.

More Information? Circle Item 27 on postcard, page 131

Compact Air Sampler

A portable, compact device for collecting samples of gases, vapors and dusts in the atmosphere is announced by Compact Air Samplers, Demarest, N. J.

All the impinger scrubbers, air pumps, and other equipment required for taking accurate air samples are included within a light carrying case. The unit weighs only 12 pounds and occupies about the same space as a portable typewriter. A metal tripod for mounting the scrubbers at convenient sampling heights completes the unit. A minimum of space and time is needed for setting up the apparatus for periodic checking of the concentration of gases and vapors in workroom atmospheres.



A small pump and motor used for drawing air through the scrubbers operates from 110 volts a.c. The scrubbers are of the usual small impinger type but designed to hold more sampling solution for long period sampling operations. Space for small reagent bottles in the carrying case makes it possible to utilize the unit in the manner of a test kit for certain determinations where the airborne substance lends itself to chemical analysis on the spot. For example, one operator could collect and analyze fifteen to twenty samples for mercury vapor in an eight hour period.

Timing devices for taking samples of the atmosphere at selected intervals can be incorporated as an accessory.

Quiet operation of the motor and pump makes it possible to conduct frequent sampling of the atmosphere for airborne bacteria in air conditioned offices and work places. At the same time, the sampler is rugged enough to be used for stack sampling where the emission is a gas or vapor.

More Information? Circle Item 28 on postcard, page 131

Low Cost Flexible Tubing

A new low-cost tubing, Flexflyte Green Label, for a wide range of industrial applications, is announced by Flexible Tubing Corp., Guilford, Conn. Intended for such applications as air handling, fume removal, and dust collection, the tubing can be used in exhaust, blowing, or gravity systems.

Made of a rust-resistant wire helix covered with high-count woven fabric coated with a tough resinous compound, it is a light weight tubing with relatively smooth bore and negligible reduction of cross-sectional area in tight bends. It has good resistance to oils, gasses, acids, alkalis, and abrasion.

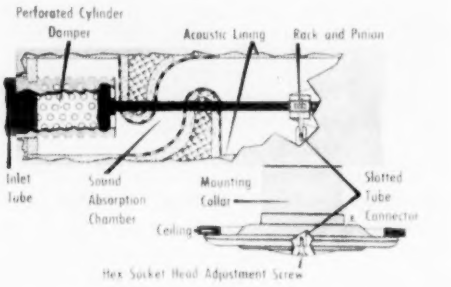
The tubing is stocked by distributors in 50-ft. lengths, from which any desired shorter lengths may be cut. Soft cuffs can be produced by removing part of the supporting wire helix at each end. The product is available in diameters from 1 to 2½ inches, in ½-inch increments.

More Information? Circle Item 29 on postcard, page 131

High Pressure Air Diffuser

The introduction of its Kno-Draft Type HPR-K high pressure air diffuser, designed to handle wide volume variations in different zones, besides providing a highly flexible distribution system, is announced by Connor Engineering Corp., Danbury, Conn.

This diffuser can be dampered from 1 to 4 inches, wg, static pressure, permitting balancing of systems where volume requirements may vary anywhere from 50 to 100 per cent from original design.



Long runs of diffusers serving large areas can be supplied by conduits of uniform size without the customary reduction for each take-off, and these high pressure systems are extremely stable.

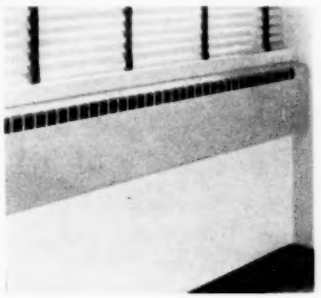
Consisting essentially of a perforated cylindrical damper, a sound absorption chamber and a standard circular diffuser, the units performance characteristics are identical to those of the standard model. Calibrated damper valve is controlled from below.

More Information? Circle Item 30 on postcard, page 131

Finned Radiation for Sill Line

High-capacity finned radiation designed to be installed at the sill-line is manufactured by John J. Nesbitt, Inc., Philadelphia, Pa.

Each unit consists of heating elements, enclosures, hanger brackets, wall sleeves, end caps, and wall strips. Heating elements are furnished in two sizes: Type A, consisting of 3¼ inch square fins on a 1 inch nominal OD tube; Type B, consisting of 4¼ inch square fins on a 1¼ inch nominal OD tube. Fins are aluminum, and tubes are seamless copper.



Enclosures are available in three types, all coming in 9 standard lengths from 3 to 8 feet. The models are: Type A, 3⅝ by 12 inches for use with Type A fin, one row high; Type B, 4⅝ by 13 inches for use with Type B fin, one row high, and Type C, 4⅝ by 20 inches for use with Type B fin, one or two rows high.

Heating capacities range from 1,250 to 2,290 Btu per hour per foot with steam at 1 psi pressure, and from 663 to 2,635 Btu per hour per foot with forced hot water ranging from 160 to 230F.

Tables for correction are available for use with room conditions that vary from those upon which these ratings are based.

A hinged, chain-operated damper, attached to and removable with the enclosure front, is available for installations where separate room or unit control is desirable.

More Information? Circle Item 31 on postcard, page 131

Packaged Liquid Chilling Unit

Liquid chilling units, pre-engineered, fabricated, and completely assembled at the factory in sizes ranging from 30 to 60 hp, are manufactured by Baker Refrigeration Corp., South Windham, Maine.

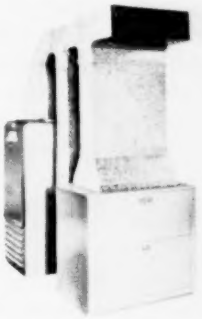
The entire line consists of units available in sizes from 10 to 60 hp, giving water cooling capacities of 22 to 160 gpm through a ten degree cooling range.

The component parts of these liquid chillers are furnished in a completed assembly consisting of a compressor, motor, gauge board assembly, dual pressure control, condenser, chiller, and heat exchanger mounted on a structural steel base and frame. A thermostatic expansion valve, liquid line solenoid and strainer, liquid sight glass, fusible plug or relief valve, thermostat and charging valve plus interconnecting refrigerant lines are also included.

More Information? Circle Item 32 on postcard, page 131

Central Air Conditioning Units

A new residential central air conditioning unit which can be easily hooked up to any forced air furnace, is placed on the market by Refrigeration Div., Aug. G. Barkow Mfg. Co., Inc., Milwaukee, Wisc.

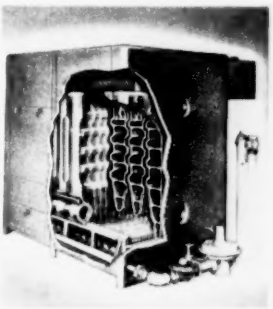


Placed alongside of the furnace, the air conditioning units require 2 by 3 feet of floor space and are 3 feet in height. One electric and one water connection, in addition to the duct work, is all that is required. The condenser is the cleanable type and is adaptable for cooling tower use if necessary. Motor and compressor are hermetically sealed with built-in overload protection. In addition to the residential central air conditioner, a commercial model is available for smaller type installations, such as small shops.

More Information? Circle Item 33 on postcard, page 131

Line of Gas Boilers, 18 Sizes

A new line of high-capacity gas boilers, the "66 series," available in 18 sizes ranging in net ratings from 1,770 to 12,950 square feet of steam radiation, and from 3,010 to 20,720 square feet of hot water radiation, is introduced by The National Radiator Co., Johnstown, Pa.



Boilers in this series can be combined with convectors, baseboards, radiators, unit heaters, radiant panels, or any other heat distribution system in large residences, institutions, commercial structures, and industrial plants.

Cast iron sections, of which the boilers are constructed, are connected with three push nipples. Tapering zig-zag flues between sections bring gases into close wiping action with heating surfaces and, combined with the long gas travel, these features are said to provide high efficiency and fuel economy.

Complete automatic controls are furnished with the units in the series. Drilled raised port burners and appropriate controls are supplied for use of natural, mixed, manufactured and LP gases, as well as LP gas-air mixtures.

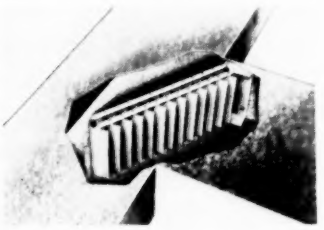
A semi-concealed draft diverter is located at the rear of the boiler and is anchored to the sections, permitting installation where head room is at a premium. The boilers are of a uniform height of 68 inches, with a width of 47 inches, and their length varies from 32 to 168 inches.

Boilers are jacketed in heavy gage steel finished in enamel, with blanket type glass wool insulation on front, back, sides and top extending from the top of the jacket to the floor.

More Information? Circle Item 34 on postcard, page 131

Extractor Controls Air Volume

A new double duty adjustable air volume extractor and controller is placed on the market by Titus Mfg. Corp., Waterloo, Iowa. It comes factory assembled and is designed to save sheet metal men time in assembly.



Designated Model AG-45, it installs with two screws. It is also made to replace an extra volume controller, and is adjustable from full-open to full-closed position.

The unit makes use of curved blades which turn to control air volume in such a manner as to bring even distribution to the entire grille face.

Controlling by turning air from the main duct, it reduces pressure losses and stops excess turbulance. The controller features heavy duty rattle free construction. Parts are made from 14 and 26 gage steel.

More Information? Circle Item 35 on postcard, page 131

Closed Flame Gas-Oil Burner

A new closed flame, dual fuel gas-oil burner, which can be used with any gas or oil fuel for firing industrial furnaces, ovens and process equipment in the operating range between 200 and 2400F, is announced by Eclipse Fuel Engineering Co., Rockford, Ill. The burner is available in 3 and 10.5 gph capacities.

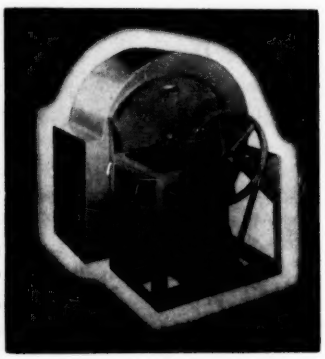
Features of the unit are high flame retention and mixing qualities for gas, and high atomizing efficiency for oil. The nozzle mixing principle employs a dual atomizing oil tip. Secondary air meets the gas or oil mixture in both a converging and rotating pattern, promoting atomizing efficiency at the nozzle exit.

A rotating main combustion air casting permits adjustments for any desired alignment of piping. Its blocks are interchangeable with those of conventional burners.

More Information? Circle Item 36 on postcard, page 131

Belt-Drive Utility Blower

Belt-drive utility blowers in sizes from 9 to 30 inches have been added to its line of propeller-type fans and blowers by Hartzell Propeller Fan Co., Piqua, Ohio.



The blowers are equipped with an adjustable motor pulley to provide for variations in speed to meet changing pressure and volume requirements. They are available with either clockwise or counterclockwise rotation; housings are easily rotated at time of installation to any of eight discharge positions. Wheels are dynamically balanced to eliminate vibration and insure quiet operation.

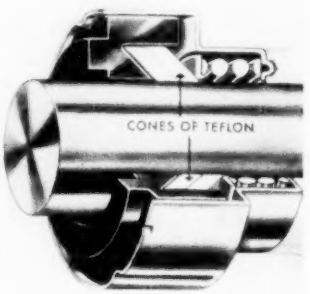
Blowers can be furnished with motors to meet all current characteristics and special operational requirements. A weather-proof drive cover, available at extra cost to fit all sizes, eliminates the need for penthouse or other special protection on outside installations.

Detailed specfications and complete air delivery tables for the new blowers are included in the firm's new blower catalog, B-10.

More Information? Circle Item 37 on postcard, page 131

Packaged Seal for Rotary Shaft

An all-purpose mechanical seal, known as the John Crane Type 19, is introduced by Crane Packing Co., Chicago, Ill.



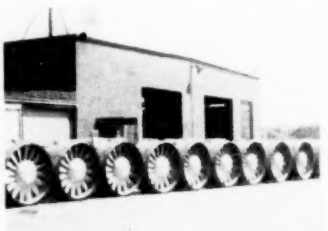
Special beveled cones made of Teflon are utilized as the flexible member. This adapts the seal for services involving water, oil, corrosives or acids; temperatures from −100 to + 450F; vacuums and pressures to 200 psi; and high shaft speeds.

Being a packaged type unit, the seal provides quick and easy installation for production assembly and replacement service. It is presently available in sizes to fit shaft diameters of ¼, ⅜, ½, ⅝ and ¾ inches. The metallurgy of the seal can be specified to meet service requirements or operating conditions.

More Information? Circle Item 38 on postcard, page 131

12 Models Added to Fan Line

Twelve new additions to its Axivane Series 1000 line are being manufactured by Joy Mfg. Co., Pittsburgh, Pa.



These new models, ranging from 66 to 84 inches in diameter, were developed to meet the demand for increased ventilation caused by the trend toward plant expansion, particularly in the aluminum industry and by manufacturers of equipment for the armed forces. Peak capacities are required for the new procedures necessary to supply ventilation for these plants. The new models are capable of producing up to 150,000 cfm at pressures as high as 11.0 inches w.g.

The entire Series 1000 line now comprises 136 models, with 19 housing diameters, 4 hub sizes, and 5 motor speeds. The line was also represented by a smaller direct drive unit, as well as a belt driven model and a controllable pitch fan.

More Information? Circle Item 39 on postcard, page 131

Control Units Come Complete

The introduction of its Zonetrol units for use with controlled systems for automatically opening and closing duct hampers of forced warm air heating systems is announced by Crise Controls Div., Acro Mfg. Co., Columbus, Ohio.

The units are designed to respond to thermostatic temperature control. When the thermostat in any zone calls for heat, the respective motor opens the damper of that zone and at the same time closes the built-in switch, which then starts the automatic heating equipment. Any number of controls can be used to control as many zones as may be required.

Economy is said to result in the fact that each control is a complete unit with no master control, power box, or transformer required. They contain a built-in low voltage control circuit which eliminates the need for the extra transformer.

More Information? Circle Item 40 on postcard, page 131

Fan for Floor and Window Use

The addition of a 20 inch combination window and floor fan to its product line is announced by Fresh'nd-Aire Div., Cory Corp., Chicago, Ill.

Measuring 22 inches high, 22 inches wide, and 5¼ inches deep, it comes complete with a window installation kit including two side panels and a mounting bracket.

In actual use, the side panels and mounting bracket are installed in the window frame, the fan is then merely hung onto the mounting bracket, thereby becoming a built-in window cooling unit. Instead of a reversing type motor, the direction of circulation, either out the window or in the window, can be changed by merely lifting the fan out of the bracket and turning it around.

One of the features of design is that the window bracket itself is installed in such a way as to enable the window to be closed behind it whenever the fan is not in use. This means that the fan can be removed from the bracket, used at any location in the house, and the window completely closed behind the bracket and side panels until such time as the fan is again hung in the window bracket for regular window cooling.

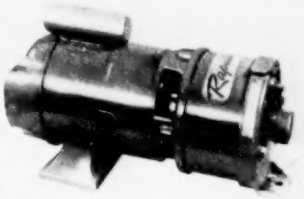
The unit has a 20 inch aluminum propeller which is mounted in rubber to assure quiet vibration free performance and has a carrying handle for convenience in transferring from room to room as needed. The unit is built with a special closed type safety guard.

The new window fan offers three speed circulation, a low speed for nighttime cooling and medium and high speeds for overall circulation Retail price will be $59.95.

More Information? Circle Item 41 on postcard, page 131

Pump Recirculates Water

A pump designed for re-circulating water for cooling compressors in residential and industrial air conditioning installations is placed on the market by the Dayton Pump and Mfg. Co., Dayton, Ohio.



Known as the Axial-Flow, the pump will be available in a range of horsepower ratings. Both single and multi stage models will be manufactured in several of capacities and pressures.

The pump is of the jet-centrifugal type and features an easily replaceable cartridge-type seal, an automatic pressure regulating valve, a bleeder-type priming valve, and a combined adapter flange and slip coupling. No special pump stand is required.

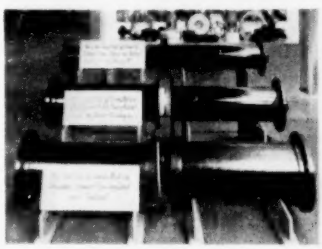
All pumping parts are made of corrosion-proof brass and water passages are designed to reduce friction losses.

More Information? Circle Item 42 on postcard, page 131

Prefabricated Piping Systems

A line of mechanically sealed insulated and conduited piping systems for underground and overhead distribution is produced by E. B. Kaiser Co., Glenview, Ill.

Called the Ebko prefabricated piping systems, they are made of materials which can withstand total submergence in water without ill effect and are designed for conveying steam, water, oil, viscous liquids, or refrigerants with protection against fire hazards and high capacity operation.



The systems are designed to be of strength enough to withstand the vibration and shock of traffic, requiring no special reinforcements or protective construction for under roadways and railroad tracks. The mechanical seal feature assures a tight installation. Simplicity of installation makes it possible to make up long runs on the ground and hoist into place for overhead and above ground installation.

All types of expansion joints are adaptable to these systems, and anchorage for the control of expansion and contraction is an integral part of the system.

These systems are shipped in standard lengths ready for installation and are built to withstand rough handling of field erection. Installation drawings are furnished and each piece of piping is marked to correspond with the drawing, eliminating all possible confusion in installing of the piping.

More Information? Circle Item 43 on postcard, page 131

PRODUCT APPLICATIONS

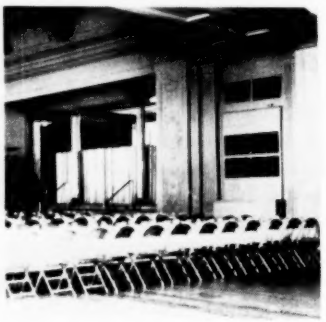
New, Unusual, or Ingenious Uses of Equipment and Materials

Conducted by WM. B. FOXHALL, Associate Editor

University Hall Air Conditioned

PROBLEM: In the Great Hall of the Memorial Union at the University of Wisconsin it was desired to install air conditioning. Although theoretical maximum load conditions indicated that as much as 80 tons of refrigeration would be required, it was determined that 40 tons would adequately take care of most uses.

SOLUTION: Two 20-ton Typhoon air handling units were installed in the conditioned area with compressors to be located in the basement, three floors below. This splitting of units was considered necessary because of space limitations, noise problems and a desire to preserve the architectural design of the hall. The hall is used as a ballroom, auditorium and dining room and is subject to cooling loads characteristic of those activities. The Typhoon units made use of the air handling facilities in overcoming a domed ceiling height between 15 and 35 ft. Units are installed on either side of a large stairway and equipped with removable covers constructed to fit between pillars. Supply air was drawn from the basement in order to eliminate cutting through the ballroom walls. Blowers for supply air were located in the basement. Ornate openings in the ceilings were used as exhaust grilles. Steam coils were installed in the supply units and air can be tempered in moderate weather or heated during cold weather.



RESULTS: After the installation was completed decibel meters and velometers were used as well as smoke tests to make sure that the installation was satisfactory. Tests show that the noise level was better than had been hoped for; air distribution was acceptable and free of objectionable drafts.

Hotel Air Conditioned While Occupied

PROBLEM: The Biltmore Hotel in Atlanta decided to provide air conditioning without shutting down for the installation of equipment.

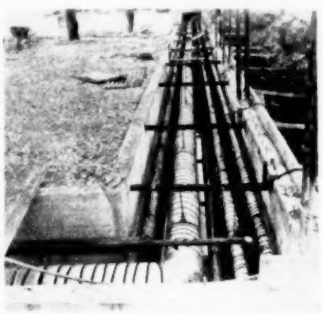
SOLUTION: It was decided to put all central equipment for a Carrier Conduit Weathermaster system on the roof of the 12 story building. A careful check was made of the hotel room occupancy cycle over the past two years. It was discovered that there was a low point in August and another in December. As the August low approached, the hotel booked guests into one wing while workmen went into the other and began sliding small diameter conduit for conditioned air from the roof down through vertical tiers of rooms. In December, room units will be put in place and attached to the conduit.

RESULTS: Since the Carrier absorption refrigerating machine will be installed on the roof, there will be no vibration from moving parts to disturb guests. The small size of the conduit allowed installation without duct work or disturbance to inside walls. The entire installation will be carried forward without sacrifice of room rental.

Glass Insulation Cuts Pipe Covering Time

PROBLEM: In construction of a new Fayetteville, Arkansas high school, the problem of insulating steam and water pipes supplying the structure was complicated by insistence on the part of the Board of Education on absolute minimum cost.

SOLUTION: Steam supply, return, hot and cold water pipes were all laid in place in an open concrete trench with all connections made and tight. Ultralite glass fiber insulation faced one side with plastic film was cut in 120 foot lengths and in widths equal to the circumferences of the various pipes to be covered, plus an allowance for overlap. At ten foot intervals, the inch thick Ultralite, product of Gustin-Bacon Mfg. Co., Kansas City, Mo., was fastened to the pipe with tape. The Ultralite was then fastened around the pipe by winding tape spirally along the pipe.



RESULTS: Workmen applied the insulation easily and rapidly. The finished job was comparable in price to use of less expensive materials. Savings were also made in ordering and storing since the same material could be used for both steam and water pipes.

Chilling Unit Supplies Water for Dyeing

PROBLEM: At the Cross Cotton Mills Co. plant in Marion, N. C., a supply of chilled water was required for a textile dyeing process.

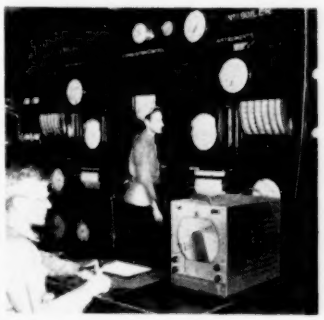
SOLUTION: The mill, which manufactures knitting yarns dyed and bleached, has installed a U. S. Air Conditioning Corp. 20-ton RKC packaged water chiller which contains, in a single casing, compressor, refrigerant water chilling section and evaporative condenser. The unit is operated in conjunction with a 5,000 gallon chilled water storage tank to spread the load on the chiller. Water in the tank is maintained at 35F and is piped to the dye machines.

RESULTS: Low temperature of the water prevents foaming with the use of certain dyestuffs. Before the chiller was installed, ice was purchased from a local plant and broken into small pieces at the mill for water chilling. The chiller eliminated the severe labor and scheduling problem.

Industrial TV Monitors Boiler-Room Operations

PROBLEM: Bad combustion in power plants results in waste of fuel, escape of valuable by-products which could be reclaimed, and often a violation of local smoke ordinances. Boiler plant employees usually cannot see their chimneys to observe when these conditions exist, or keep constant watch over furnace flame conditions.

SOLUTION: RCA's small portable industrial television chain can be mounted at inaccessible locations to monitor stacks or furnace flame and provide valuable information regarding combustion conditions. The unit can be provided with an explosion-proof and dust-proof housing which can be shock-mounted or air-cooled if desired. Standard photographic filters can be used in conjunction with the camera's vidicon tube to allow the boiler operator to view actual flame outlines not visible to the human eye.



RESULTS: Fuel savings due to good combustion more than offset cost of equipment and expense of operation, while elimination of smoke nuisance and violation of local ordinances create company good will in the community. Used for furnace flame observation, the equipment also provides a safety measure when igniting boiler flames.

Brominated Carbon Saves Orchids

PROBLEM: The average life of an orchid after cutting is about ten days. Deterioration, once begun, proceeds rapidly. As the flower matures, it has been found that certain gases are given off which, if confined, have a tendency to speed up the aging process. In addition, flowers and other plants are subject to attack by disease-producing mould spores.

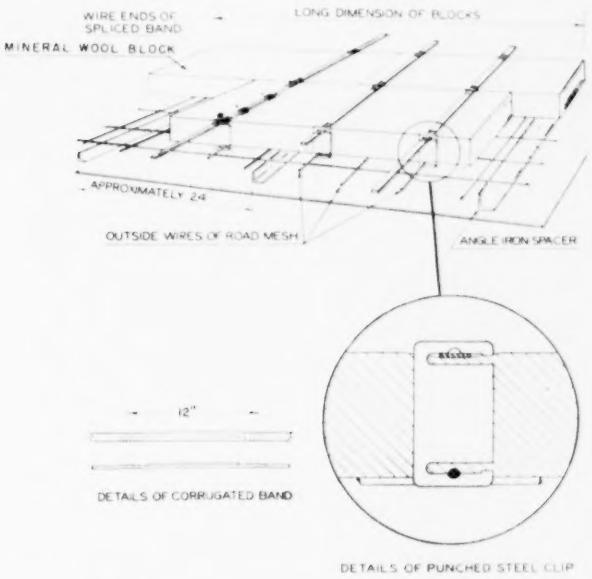
SOLUTION: Drawing on their experience in prolonging the life of apples in storage, horticultural scientists found that a small quantity of brominated carbon in bags stapled to the inside of the shipping container would slow down the aging process and control disease in orchids. The brominated carbon is a product of W. B. Connor Engineering Corp.

RESULTS: While not much has been learned about how this preservative acts, it is thought that the bromine in the carbon reacts with ethylene which is known to be one of the gases evolved during the ripening process. Bromine also retards the growth of mould, and orchids are found to last three to five days longer.

Mineral Wool Blocks Spaced on Ducts

PROBLEM: For dependable and efficient methods of insulating high temperature gas and air ducts, the advantages of a rigid insulation are desireable.

SOLUTION: Good appearance and a tight heat barrier are provided by spaced application of mineral wool duct insulation supplied in blocks, usually in 12 x 36 inch sections. The materials required in addition to the mineral wool insulation are 6 x 6 inch wire mesh, corrugated steel bands, and special punched steel clips. The wire mesh is stretched over existing ribs, flanges, and stiffeners on the duct work and is tack-welded. Gaps around flush openings are filled with miter-cut sections of mineral wool blocks wired to the mesh. The block sections are applied in parallel rows and secured to the mesh by ¾ inch corrugated steel bands which are held in place by steel clips. The punched clips are snapped over the outside wires of the mesh and the steel bands between each row of block insulation. Thus each block of insulation is individually attached to the wire mesh foundation. Plasterer's corner bead is installed on edges and outside corners of the ducts. Mineral wool cement and finishing cement are applied over the block insulation to level off the surface, and the insulation may then be finished with asphalt



weatherproof mastic trowelled over 1 inch galvanized wire netting stretched tightly over the cement surface.

RESULTS: According to the Industrial Mineral Wool Institute, a versatile, dependable and efficient method of insulating high temperature ducts is provided. Because the insulation is not applied directly to the duct surface, less special expansion joint treatment is necessary.

Cafeteria Has Radiant Ceiling

PROBLEM: At the Clifton, N. J., plant of Shulton, Inc., manufacturer of toiletries, a remodeled cafeteria required heating, cooling and sound control systems.

SOLUTION: A radiant ceiling which in addition to heating or cooling, absorbs unwanted sounds was installed. The ceiling is manufactured in modular units by Burgess-Manning and is an adaptation of the Frenger system in use in Europe for several years. The Shulton cafeteria has 4,000 sq ft of the Burgess-Manning radiant ceiling, which is an arrangement of pipes fastened to an acoustic face. Heat is provided by hot water pipes behind the perforated aluminum panels. In warm weather, cold water flows through the pipes and radiantly cools the room.

RESULTS: Warm or cool air is introduced into the room through the ceiling without convection drafts. The sound control feature absorbs noise such as clatter of dishes.

Experience is my Classroom

By T. W. REYNOLDS

• BOILER TUBE HEATING SURFACE

Not infrequently the engineer has to decide whether it is the inside or the outside of a boiler tube that is the heating surface. The question is interesting, not definitely settled, and subject to confusion. Now a book recently published abroad says the solution of this problem is rather simple and that when the heating and heated media are under about the same conditions and have similar properties, we can take the average of inside and outside surfaces as the heating surface. Such conditions are shown by *A* and *B* of Fig. 1.

For other conditions, the book says the heating surface is that which is doing the most difficult job, illustrated by *C* and *D*, where it is held to be more difficult for the metal to take up heat from the gases than it is for the metal to transfer that heat to the water. However, it seems to the writer that we are only interested indirectly, as a matter of economy, in the heat transferred from the gas and are most interested as a matter of obtaining results in the heat transferred to the water. Whether one accepts this viewpoint or the other, two identical boilers with the same size of boiler tubes will have a total of heating that will vary substantially depending upon which side of the boiler tubes are considered as heating surface.

The book further holds to the idea of most difficult heat transfer by citing the case of heat transfer from water to oil, *E*, and from oil to water, *F*. The surface contacting the oil is claimed as heating surface on the contention that the oil being viscous, the heat transfer from the oil to metal will be slower than from the metal to the water.

This book leaves the question of what is heating surface far from settled. It is a question whether or not the gas side does the more difficult job. On most steel boilers it is comparatively easy to maintain a clean surface on the gas side, but the scale which forms on the water side provides a very effective insulator.

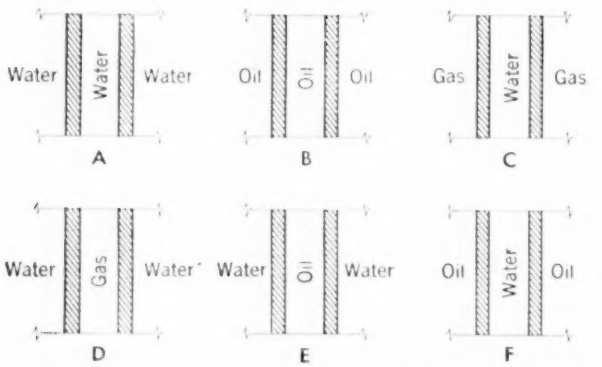


Fig. 1. Conditions of heating surface for boiler tubes.

In many discussions concerning the relative merits of measuring heating surface, actual data on the subject gives very little difference in heat transfer, providing the circulation of the water and gases remain constant in the cases being compared. High water or gas circulation through a boiler tube will increase the heat transfer. Advocates of measuring heating surface on the water side of a tube in a fire tube boiler point to an increase in heat transfer whenever the surface of the metal in contact with water can be increased, and, of course, this is true when fins are used on tubes.

It has become common practice in the steel boiler industry to measure heating surface on the water side of fire tubes and on the fire side of water tubes. This keeps heating surface to the outside of boiler tubes in either case. However, the design of a boiler has much more to do with the effectiveness of heating surface than any differential between heating surface measured on the outside or inside of tubes. This question has been the cause of loud and long discussions.

• THE TRUTH ABOUT SAVINGS

The late James A. Donnelly, a pioneer in certain phases of steam heating and a charter member of ASHVE, pointed the way in earlier days for proper steam circulation in pipes. He also did a good job of selling his heating specialties, particularly to industries around Brooklyn and New Jersey. Many of the plants were sold on the basis of savings guaranteed where such devices were installed. Such promises involved no risk of failure because the thermal savings produced by the specialties were always greatly added to by the savings due to the incidental plant changes which Mr. Donnelly invariably directed. The average plant in those days was certainly in need of improvement. Many still are.

All this comes to mind because of a proposal before me. The question is: Should an owner add a lot of equipment to provide a desired increase in output when the money required will be hard to obtain. The answer is no, at least not in the particular case presented, because the additional capacity is there, although this capacity can be considered as latent or hidden.

Aside from the usual much needed maintenance, the process in question could be greatly helped and output increased simply by using live steam direct instead of using steam to heat hot water which indirectly heats the process, slowly and inefficiently. Use of live steam eliminates steam traps and any condensate formerly wasted to sewer, while

(*Continued on page* 128)

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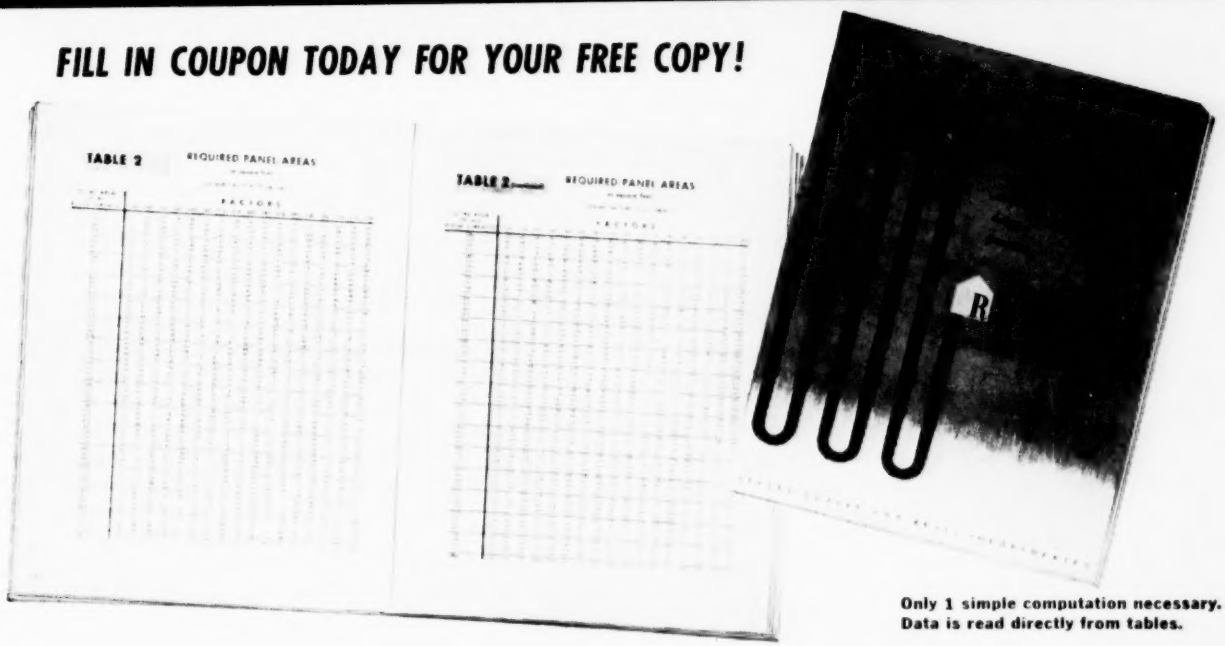

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(*Continued from page* 126)

the absence of steam coils in the bath will provide the much needed space for additional product.

• PRECAUTIONS WITH ANTI-FREEZE SOLUTIONS

Anti-freeze is and has been used directly in boilers as shown in Fig. 1, but in snow melting systems it is commonly confined to a heat exchanger as shown in Fig. 2. In a residential heating system, a flow control valve is used on the supply main and another on the return main, provided there is any possibility of reverse circulation. In Fig. 2, however, a flow control valve is usually required only on the anti-freeze side of the system, because reverse circulation is not likely, the radiation being at low level and heat being applied only when snow is to be melted.

One other difference from a residential heating system is that the cold water fill is made only when required and then by means of a rubber hose connection. This complies with local code requirements which prohibit any direct or permanent connection to the city water lines so as to prevent possible contamination of the drinking water supply. It also eliminates any chance of dilution of the anti-freeze due to back siphonage or the automatic addition of make up water to replace any solution escaping through air vents, valve stems and pump glands. For the last mentioned reason, a snow melting circuit should be arranged to operate separately from any circuit not containing an anti-freeze solution.

The anti-freeze used is often either a propylene glycol or ethylene glycol base with an added anti-corrosion inhibitor. Breakdown of the anti-freeze mix could be occasioned by excessive temperature anywhere within the boiler. As a consequence, care should be taken to avoid this by an immdiate start of circulation when firing, and by control of the maximum temperature of the mix.

The anti-freeze manufacturer should be consulted as to his limitations on maximum system temperature and corrosion. His directions should be followed as to when to put new or additional anti-corrosion inhibitor into the system, since any inhibitor may tend to neutralize after a

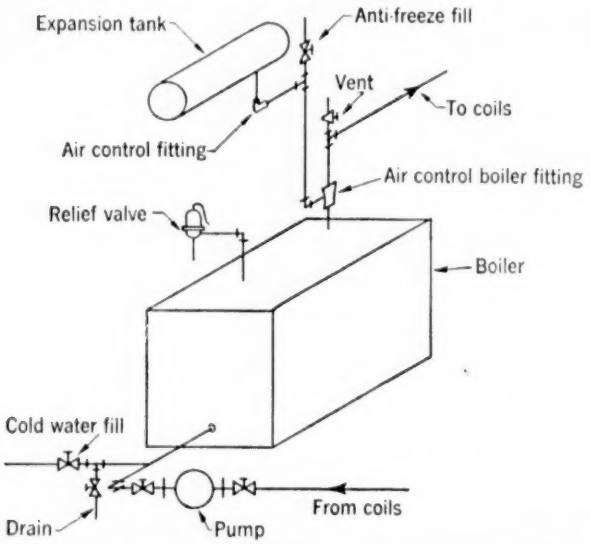

Fig. 1. Anti-freeze system used directly with heating boiler.

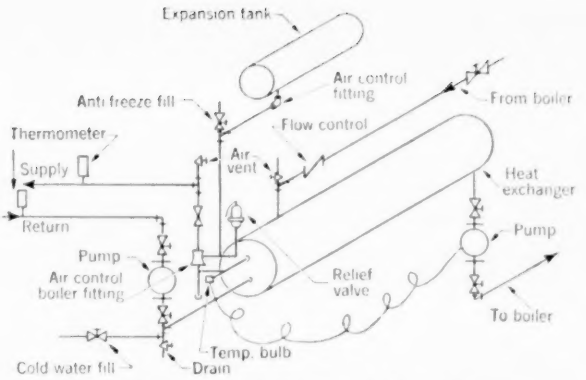

Fig. 2. Snow melting hookup with heat exchanger.

time. A great many systems have been installed without any noticeable corrosion from anti-freeze, but no doubt most systems have not been in operation long enough for their inhibitors to be used up in neutralizing formed acids. When this does happen, the system may be attacked by corrosion if new inhibitor is not added. The following comments in this connection do not apply to any specific anti-freeze and should therefore be checked with the manufacturer and exact data obtained.

It is possible for ethylene and propylene glycol in the raw or uninhibited state to attack any steel or brass in a system. The hydrocarbons of the anti-freeze, together with oxygen in the system, when subjected to temperatures of 300F or higher will break down into acid and start attacking the metal. Heating of the anti-freeze should be by means of a heat exchanger with a heating medium of hot water below a temperature of 285F, or with steam below 40 psig.

Some decomposition of the acid formed may also occur at temperatures below 300F. Such action will depend upon temperature and the amount of oxygen present. However, the possibility of anti-freeze attack is minimized in a closed snow melting system having proper provision for air elimination. Only where the temperature is high and the air is allowed to remain in contact with the anti-freeze, will the system be attacked. In this connection it should be remembered that air is always present in the compression tank, hence the water in the tank should be maintained at low temperature. This can be done by leaving the tank without insulation and by using an air control fitting for the tank.

A system containing anti-freeze should be very tight, otherwise there will be leakage due to the low surface tension of the compound. Welding and soldering will reduce the number of threaded joints. A further note is that the pump shown in Fig. 2 need not necessarily be mounted in the vertical pipe. The vertical pipe position is theoretically preferred because of the possible elimination of air binding and accumulation of solids.

A design water temperature drop of 10F is recommended for snow melting with anti-freeze solution. While this appears rather low, the decreased specific heat and increased viscosity of glycol anti-freeze mixtures may raise the drop to as high as 15F. Considering only the decrease in specific heat, a 50% glycol solution would cause a 13F drop. High temperature drop not only reduces capacity but also causes uneven melting of snow. There is need, therefore, for a decrease in temperature drop and an increase in circulation.

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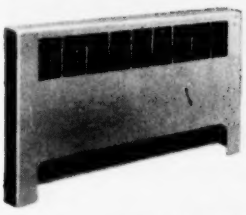

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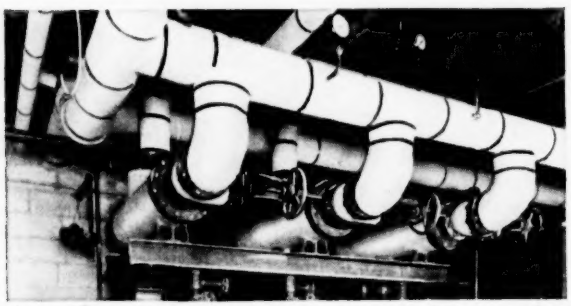
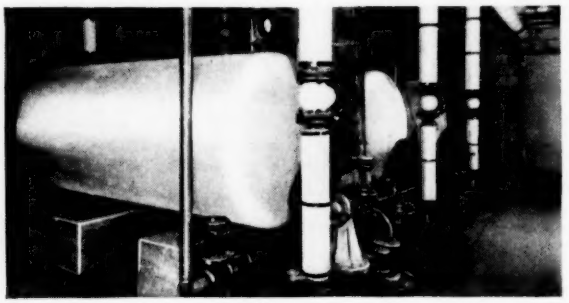


Three **p-k** Hot Water Converters are in use at the new, modern Rittenhouse-Savoy, on fashionable Rittenhouse Square, Philadelphia. Each heats 480 gpm of water from 160°F to 180°F with steam at 25 psig pressure. Steam supply is purchased from public supplier.



Three 48" x 120" Type B **p-k** Hot Water Storage Heaters, each containing two heating elements. Each has a live steam section to heat 2000 gph from 40°F to 180°F with steam at 5 psig. A 50 sq. ft. condensate cooler is built into each section.

the **Patterson-Kelley Co.,** *Inc.*

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NEW CATALOGS

INDUSTRIAL CLAY PIPE

A new illustrated folder explaining the applications for its Screw-Seal industrial pipe is made available by The Robinson Clay Product Co., Akron, Ohio. This clay pipe employs phenolic collars and cast-on threads of Plastisol to make a tight acid-resistant joint, which can be deflected six degrees without leakage. A 6-page bulletin with complete installation instructions can also be obtained. ..... **Item 44**

GUIDE FOR COMBATING CORROSION

A new illustrated brochure, Where to Use Coal Tar Protection, designed to help solve corrosion problems, is released by Tapecoat Co., Evanston, Ill. Based on experience in serving gas and oil fields, transportation and communication, water and sewage and chemical and industrial applications, the brochure presents practical suggestions to combat corrosion. It includes details on how and where coal tar protection can be used to best advantage and offers case histories to show how corrosive problems have been overcome in many fields. ..... **Item 45**

PORTABLE CENTRIFUGAL PUMP

Bulletin 151, on its newly designed 1½ inch self-priming centrifugal pump is issued by Carver Pump Co., Muscatine, Iowa. The new bulletin describes this gasoline engine driven pump which is portable. The pump handles 6000 gph at 17 ft suction lift against 17 ft total head and will prime in less than 30 seconds with the pump 10 ft. above water... **Item 46**

FIN PIPE COIL CATALOG

An 8-page folder, Form 675-Revised, covering its commercial line of fin pipe coils and covers, is published by Kritzer Radiant Coils, Inc., Chicago, Ill. Illustrations and diagrams show the types, construction, and uses of the coil, and the dimensions and specifications for all units are given in tables. The catalog covers fin pipe coil, expanded metal covers, flat top covers, access panels, slope top covers, standard hangers, and accessories. Installation directions are given in text, illustration, and diagrams. ..... **Item 47**

STORAGE AND MAINTENANCE

A new catalog, featuring steel shelving, lockers, and storage and maintenance equipment for industrial and institutional use, is issued by Precision Equipment Co., Chicago, Ill. The catalog illustrates, describes, and lists dimensions and prices for every item in the firm's line. Cartoons are included throughout the 32-page booklet. ..... **Item 48**

ENGINEERING DATA MANUAL

Engineering data manual, No. 2695, containing detailed, illustrated information pertaining directly to heating problems, is published by C. A. Dunham, Co., Chicago, Ill. The manual has 28 pages and is in 8½ x 11-inch size. Besides five pages devoted to heating terminology, there are sections covering steam data, water properties, piping data, weights and measures, and pipe and fitting dimensions. Also included in the manual is a three-page chapter giving miscellaneous facts, including temperature conversion formulas, decimal equivalents, electrical unit equivalents, capacity of round and rectangular tanks, and weights of sheet steel. ..... **Item 49**

GAS, OIL, & COMBINATION BURNERS

A new 8-page Bulletin P-152 illustrating and describing its Pac-O-Matic oil, gas and combination gas and oil burners for industrial, process and institutional heat and power is issued by Coen Co., San Francisco, Calif. These completely packaged preassembled units require only mounting to furnace and piping and wiring connections. Available in 15 standard sizes. ..... **Item 50**

ELECTRIC BLAST COIL HEATERS

Bulletin E-97U, a 12-page catalog on its line of electric blast coil heaters, is published by Industrial Engineering and Equipment Co., St. Louis, Mo. The booklet covers a general description of the units, construction details, pressure drop curves, tables of specifications, instructions for ordering, and magnetic contractors. Illustrations of heaters and installations are included, and sample uses such as in industrial plants, department stores, and super markets, are shown. Units are recommended for use in connection with air conditioning installations. .... **Item 51**

ALL-PURPOSE HUMIDIFIER

Bulletin 52A, covering its models 300 and 300B Hum-O-Zone heavy duty, high capacity all-purpose humidifier, is issued by Daffin Mfg. Co., Lancaster, Pa. Aided by illustrations, the 4-page folder describes the construction, interior, and applications of these units. A cross-section diagram, list of specifications, and table for determining relative humidities are included. ..... **Item 52**

LINE OF DISC-TYPE VALVES

Bulletin 1000, describing and illustrating its complete line of valves embodying disc type construction, used for operating air and hydraulic cylinders, single and double acting, and air motors, is available from Ledeen Mfg. Co., Los Angeles, Calif. The bulletin includes illustrations, operating and circuit diagrams, and dimensions and weights. Valves are available in hand, foot, power and solenoid operated models. ..... **Item 53**

STEAM BOILER UNITS

Bulletin No. 508, an 8-page booklet describing and illustrating steam boiler units of oil, gas, or combination oil and gas types, is released by Johnston Bros., Inc., Ferrysburg, Mich. Features of the units are listed, and typical installations are pictured. Directions for operation and servicing are included. ..... **Item 54**

BOILER CONTROL CATALOG

Bulletin 1007, a 10-page booklet describing its boiler control panels for combustion, feed water, boiler steam temperature, and soot blower controls, is distributed by Copes-Vulcan Div., Continental Foundry and Machine Co., Erie, Pa. The booklet illustrates, with pictures and diagrams, panels and controls for metering, control, and drive. ..... **Item 55**

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PANEL HEATING MANUAL

A 28-page booklet entitled A Simplified Design Procedure for Radiant Panel Heating, intended to eliminate time-consuming heat loss calculations in the layout or installation of such residential systems is published by Revere Copper and Brass, Incorporated, New York, N. Y. Conventional arithmetical computations have been replaced by three sets of tables from which can be found required panel area in square feet and six other design data, all based upon information obtained from the room to be heated. These data include approximate heat input of the proposed panel installation, recommended tube spacing and size, desired approximate mean water temperature, total length of tube needed for each panel, length of tube for each coil with either standard or a high head circulator, and suggested sizes of mains, branches, and pumps for the entire system. The design itself is reduced to four steps, only one of which, the first, involves any calculation whatsoever. Balance of booklet is devoted to forming radiant heating coils, suggestions on positioning them, bending tools, installation details, and instructions on solder joint. . . . . **Item 56**

FILTER ADSORBER PLATES

A 4-page folder, describing the advantages, applications, and design of its model FF filter adsorber plates, is issued by Pur Air Div., American Solvent Recovery Corp., Columbus, Ohio. The folder contains illustrations, diagrams, and specifications for the various models in the line. Composition and methods of combining filter-fold units are described, and other units for duct installation are shown. The units use activated, coconut-shell carbon for odor removal. . . . . **Item 57**

FRESH AIR IN AN OFFICE BUILDING

Bulletin No. 121, an 8-page booklet entitled Fresh Air Makes You Feel Good, is released by Niagara Blower Co., New York, N. Y. The bulletin presents illustrations of an air conditioning system using the firm's liquid absorbent, Hygrol which was installed in the Arkansas Power and Light general office building. The principles of the system are shown by means of a diagram. . . . . **Item 58**

PRESSURE RELIEF VALVES

Folder FN-40, illustrating and describing its complete line of automatic, self-closing temperature and pressure relief valves, is published by Watts Regulator Co., Lawrence, Mass. The folder covers the following items: N40 series automatic temperature and pressure relief valves, comprised of four models for application in all home sized systems and some commercial systems; A54 series automatic temperature and pressure relief valves, comprised of four models for home installations; No. 140 and 240 automatic temperature and pressure relief valves for medium to large hot water supply storage tanks in commercial, industrial and institutional systems; No. 340 fully automatic pilot operated temperature and pressure relief valve for the largest hot water supply storage tank in hospital, hotel, apartment and industrial installations; and the No. 401T for temperature relief only, used to complete the protection of systems where only pressure relief has been provided, or where separate temperature relief valve is desired. . . . . **Item 59**

EQUIPMENT FOR INSTITUTIONS

A revised catalog of its line of equipment for buildings and institutions, Bulletin WP-1099-B27M, is released by Worthington Corp., Harrison, N. J. The publication covers condensed information on sizes, dimensions, capacities, ratings, and features, of air conditioning and refrigeration products, with auxiliaries; oil, gas and dual fuel engines; deaerators and deaerating heaters; water conditioning; steam turbines and turbine generators; liquid meters; centrifugal pumps; regenerative turbine pumps; vertical turbine pumps; and multi-V-drives. . . **Item 60**

ELECTRIC HEATING CATALOG

A 1953 edition of its catalog on Calrod electric heaters and heating devices is announced as available from General Electric Co., Schenectady, N. Y. Designated as GEC-1005D, the 60-page, two-color information and buying guide describes the equipments in terms of application, special features, installation, and pricing. Indexed by process and application, the catalog also contains methods of determining power requirements and heat losses by applications. These are explained by both graphs and formulas. Another feature of the publication is an index of available application bulletins, data, and specification sheets. A total of 175 photographs and drawings illustrate the various heater-types of products, including immersion, strip, cartridge, tubular, insertion, and fin heaters. Other devices described are melting pots, thermostats, switches, oven heaters, and induction heaters. . . . . **Item 61**

VITRIFIED CLAY PIPE

A 44-page catalog covering its complete line of vitrified clay pipe, fittings, flue lining, wall coping, fire and face brick is issued by The Evans Pipe Co., Uhrichsville, Ohio. Spiral bound, this catalog is pocket-sized, step-indexed for easy reference, and illustrated. . . . . **Item 62**

EVAPORATIVE CONDENSER MANUAL

A new evaporative condenser installation, operation, and maintenance manual is announced by Baltimore Aircoil Co., Inc., Baltimore, Md. This book provides information for air conditioning and refrigeration engineers, contractors and all operating and maintenance personnel. Fully illustrated with many drawings and charts, it is divided into two sections. The first deals with installation and operation, showing the theory and selection of evaporative condensers with tables and sample diagrams. The second section takes up the problem of maintenance and contains general information and details for periodic servicing. . . . . **Item 63**

BASEBOARD HEATING CATALOG

Form B752, a 16-page catalog presenting information on five designs of baseboard heating, is issued by Kritzer Radiant Coils, Inc., Chicago, Ill. The designs cover applications for heating residences, apartments and hotels, offices, hospitals and schools, and institutions and factories. Cross-sectional diagrams show component parts of the five types. The construction, control, and installation of the models are explained, and accessories and specifications are listed. . . . . **Item 64**

ALL-STEEL PILLOW BLOCKS

Bulletin A-620 on the line of Dodge-Timken steel pillow blocks is issued by Dodge Mfg. Corp., Mishawaka, Ind. Use has been made of colorful illustrations to help bring out the feature of this new pillow block. Three pages are devoted to technical information designed to be helpful to any engineer in determining whether this will solve his problem. Two pages of data will enable the engineer to select the right size for any particular application. . . . . **Item 65**

TRANSFORMER BUYER'S GUIDE

The 1953 edition of its instrument transformer buyer's guide, containing basic, up-to-date information on its complete line, is announced as available from General Electric Co., Schenectady, N. Y. The fully illustrated, 102-page publication, GEA-4626F, contains ratings, ASA accuracy classifications, and prices of all indoor and outdoor potential and current transformers. Listings of ratio and phase-angle tests, together with tables covering the mechanical and thermal limits of current transformers, are included. **Item 66**

AIR CONDITIONING MANUAL

Catalog 1401, the new 68-page service manual for installation, initial operation, and maintenance of its line of air handling and conditioning equipment, is published by Clarage Fan Co., Kalamazoo, Mich. The book contains designations of the machinery and general information on various functions, including special chapters for bearings, couplings, V-belt drives, and vortex control. Fans, ventilating sets, air conditioning units, unit heaters, and propeller type heaters are also treated individually. Instructions for ordering repair parts are given. Many illustrations, diagrams, and tables are included. This booklet will be sent only to people who write to the firm upon their business stationery, requesting the manual.

PLEASE SEND US MORE INFORMATION. Circle below item numbers on which you wish further information.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
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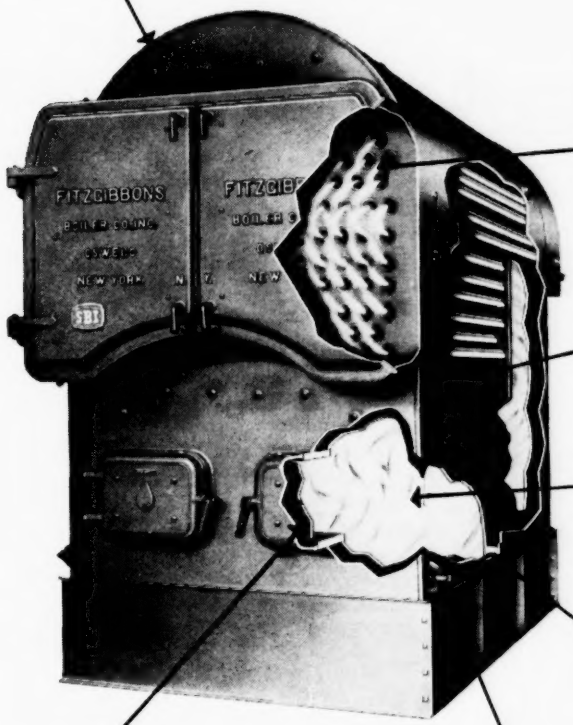
WHY THE FITZGIBBONS BOILER "D" TYPE IS

7 ways better for big buildings

1 Steel Construction — heavy "flange" quality steel plate is electrically welded to provide strength and durability. Workability of steel permits boiler design for quick, economical transfer of heat.



2 Easy Cleaning For All Surfaces — tubes are reached through large doors at front of boiler. Firedoors give ample access to firebox heating surfaces.

3 Rapid Water Circulation — concentration of heat at high point of crown sheet and unimpeded waterways induces faster circulation, brings more water in contact with more heating surface in a given time.

4 Complete Combustion — firebox of adequate height and volume provides maximum efficient burning of fuel. Ideal for oil, gas, or coal (stoker or hand-fired).

5 Welded Mud-Ring Design — a heavy steel bar is welded between sidewalls of shell and firebox to give added strength to water-leg section and longer life to the boiler.

6 Waterside Inspection — hand holes, 3" x 4½" large, permit complete inspection and cleaning of crown sheet and water-leg. From 6 to 14 hand holes depending on size of boiler.

7 Rugged Door Frame — water-cooled fire door frame of extra-heavy steel is welded between shell and firebox water wall. An asbestos gasket-sealed, soot-tight fire door completes the assembly.

All these features add up to economy, long life, and low maintenance cost. Fitzgibbons boilers meet or exceed ASME code requirements in all construction details; are certified by a Hartford Inspector. Sixteen sizes from 876,000 Btu to 10,200,000 Btu. For complete details, write to the Fitzgibbons Boiler Company, Inc., 101 Park Avenue, New York 17, N. Y. Ask for catalog HV-3.

SINCE 1886 MOST ECONOMICAL IN FUEL THE FITZGIBBONS BOILER 1886

SBI

THE FITZGIBBONS BOILER®

NEWS OF THE MONTH

HELIO-LABORATORY

rises 15 stories above the ground. Johnson lab eliminates obstructing ducts with shaft and hollow floors.

When plans were projected for the design of the new Johnson wax research and development laboratory, it was decided to avoid, if possible, flat laboratories with ducts running everywhere and walkarounds for everybody. S. C. Johnson and Son, Inc., retained Frank Lloyd Wright to design the research center, and the solution proposed was to build the laboratory upwards in the air.

• **DESIGN.**—The new Helio-lab, as it is called, is built around and cantilevered from a concrete stack anchored 54 feet into the ground and rising 15 stories to a height of 154 feet above ground level. This stack or shaft contains five hollow risers cast integral with the shaft and consisting of a round central core, a round elevator riser, a stairwell, and two risers for the air conditioning and exhaust.

• **PIPES AND DUCTS.**—The central riser which forms the hollow core of the shaft, carries around its perimeter about two dozen intake and exhaust pipes that service the building. These pipes are separated by sheet metal partitions from the conditioned air flow in the heart of the shaft. A horizontal duct-system, cast in the hollow, reinforced concrete floors, is connected to the vertical hollow of the shaft.

• **SQUARE FLOORS.**—The lab is comprised of alternate square and round floors. The square floors contain about 1,400 square feet of floor area, and from each of them an outer glass shell hangs firm to the square floor below. This shell is formed of glass tubes laid up like brickwork outside, held in place by small vertical aluminum stanchions, and sealed horizontally by a new plastic. To offset the high rate of heat conductivity of the outer walls, an inner screen of plate glass was clipped to the aluminum stanchions of the tube walls and made movable for cleaning purposes.

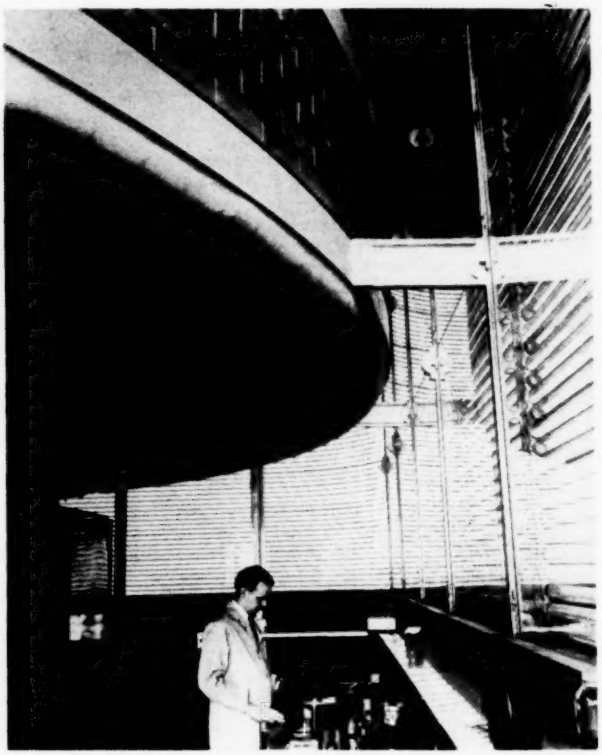
• **ROUND FLOORS.**—The round floors alternating with the square floors contain about 900 square feet of floor space, and since they do not extend to the outer walls, these mezzanine floors provide for the easy installation of tall laboratory equipment around the walls of the square floors.

• **AIR CONDITIONING.**—The air conditioning system of the lab is as much a part of the basic design as are the floors and walls, and instead of being installed in the usual sense, is an integral part of the construction, lending strength instead of requiring support.

Outside air enters the system through an electro-static type filter, is cooled and dehumidified in summer, or heated in winter, and discharged by a fan at the basement level to the air supply shaft. This air is heated to 65F in winter and cooled to 60F in summer.

(*Continued on page* 134)

Helio-Laboratory in Johnson Wax Research Center rises 15 stories off the ground. Center shaft houses risers for air conditioning and exhaust ducts cast in floors.



Square floors extending to outer walls alternate with round floors. Air is discharged to rooms through 24 combination lighting and air diffuser fixtures on each floor.

Here's the answer to simple, efficient, economical year 'round air conditioning

The REMOTAIRE
by AMERICAN-Standard

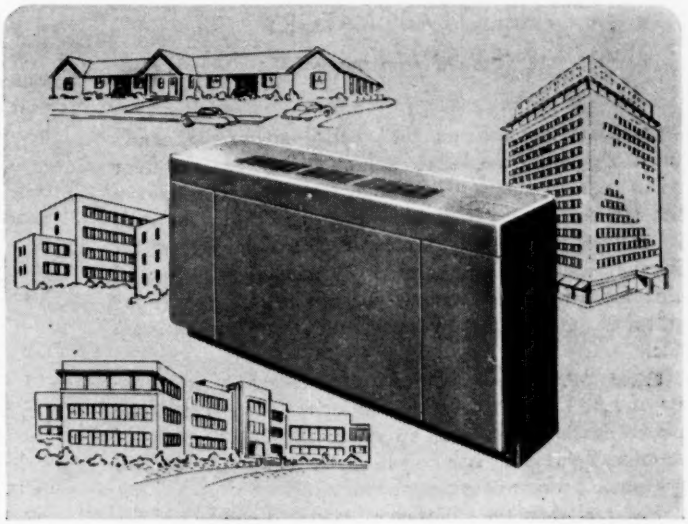
a new remote type unit for multi-room installations

Heats in Winter
Cools in Summer

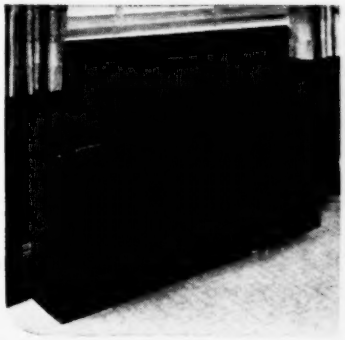
■ The Remotaire is an individual room remote type unit for providing year 'round air conditioning for central plant multi-room installations.

The Remotaire, as part of a Remotaire system, uses chilled water from a central water chiller for cooling and hot water from a central heating plant for heating. Individual control of each unit allows the occupant to choose the room temperature that suits him best without affecting adjoining spaces.

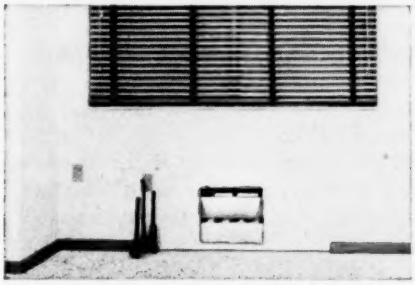
The Remotaire is enclosed in an attractive cabinet of sturdy, reinforced steel—plus a reinforced air grille—which adds to permanence and long-lasting beauty of unit. Designed for location under windows, this unit can be free standing or recessed into wall four inches.



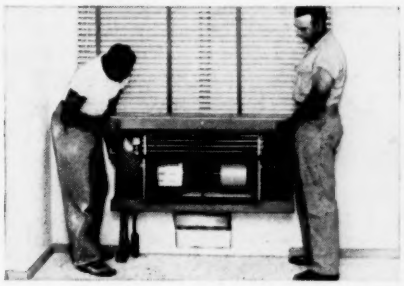
For hotels, motels, apartments, hospitals, offices and industrial buildings and other types of installations.



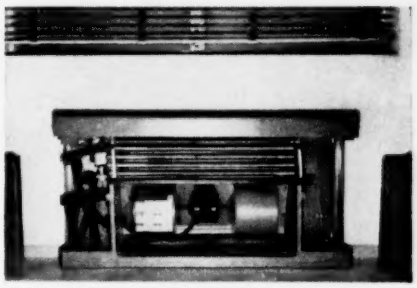
The REMOTAIRE Wall Aperture System is ideal for New Construction



LOCATION READY for Remotaire shows wall aperture, water supply, return, and condensate pipe stubs, and wall plug for electrical connections.



REMOTAIRE is set in place and leveled. Piping and electrical connections are made and pipe insulation applied.



HERE IS THE REMOTAIRE (with panels removed) showing the piping and electrical connections and pipe insulation completed.

As shown in the pictures above, the Remotaire, as part of a Remotaire Wall Aperture System, can be readily installed in the average building since piping connections are the principal installation requirement. Ventilation air is introduced through a small wall aperture behind each unit thus eliminating use of large, expensive, space-consuming ductwork. Other Remotaire systems, using other methods of ventilation, are ideal for modernization as well as new construction. Write for Remotaire Brochure, Form 298.

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P. O. Box 1226, Pittsburgh 30, Pennsylvania

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HEATING-COOLING

Serving home and industry:

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS & WALL TILE
DETROIT CONTROLS · KEWANEE BOILERS · ROSS EXCHANGERS

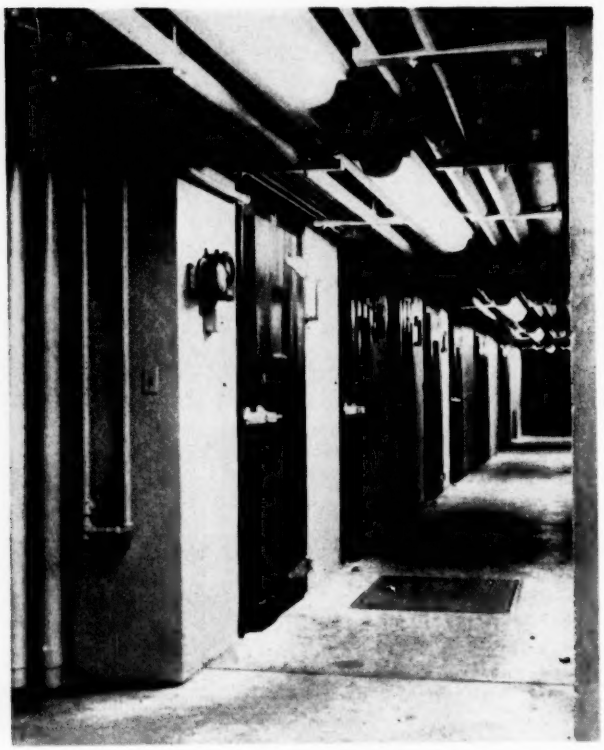
HELIO-LABORATORY

(*Continued from page* 132)

• **DISTRIBUTION.**—From the central shaft, the conditioned air enters the horizontal ducts between the floor and ceiling of each level through two reheaters, one on each side of the shaft, and is discharged into the conditioned space through 24 combination lighting and air diffusion fixtures. Each of the 24 fixtures supplies 65 cubic feet of conditioned air per minute, subject to the control of the reheaters by individual thermostats on each floor.

• **EXHAUST.**—Air is exhausted from each floor at the rate of 1,300 cfm through two 14-inch square grilles, one in each of the two exhaust-air risers on opposite sides of the stack. Each grille has an automatic damper, controlled by a static pressure regulator, that slows or shuts off the exhaust air when the difference between outside and inside pressure varies more than .01 inch of water. Variation of pressures is a common occurrence, since many of the floors are equipped with fume hoods used by chemists and engineers in their experiments to prevent contamination. No air is recirculated.

• **COOLING SYSTEM.**—The 375-ton York Corporation turbo water cooling system cools 840 gpm of water from 55 to 45F, and this water, in turn, cools nearly 75,000 cfm of air. This conditioned air is divided four ways, with 23,000 cfm going to the tower, 20,000 cfm to the administration building, 22,655 cfm to the administration annex, and 8,800 cfm to the pilot plant.



Seven separate air conditioning systems control individual temperature and relative humidity variations which are specified for each of these seven test rooms.

• **FOUR CONTRACTS.**—This project actually involved four separate contracts, the others being for a drinking water cooling system utilizing a 1 hp York condensing unit, a cafeteria air conditioning system utilizing a 7½ hp York system, and finally, a contract covering seven systems for controlling conditions in as many different test rooms.

• **SEVEN SYSTEMS.**—System No. 1 is designed to maintain any temperature from zero to 40F at any time of year. System No. 2 is designed to maintain any temperature from 40 to 100F, and relative humidity of 40% at 60F and 75% at 100F. System No. 3 is designed to maintain any temperature from 100 to 140F without humidity control.

System No. 4 is designed to maintain any temperature from 100 to 140F, and relative humidity of 35 to 40% at 100F and 75% at 140F. System No. 5 is designed to maintain a constant relative humidity of 50%. The temperature is not tied down but may be varied between the limits of 77 and 90F to hold the relative humidity constant. System No. 6 provides only ventilation and heating of from 70 to 75F of the salt spray and humidity room. System No. 7 is designed to maintain a constant temperature of 77F with an allowable variation of two degrees, and a constant relative humidity of 50% with an allowable variation of one degree in dewpoint temperature.

PLASTIC PIPE RESEARCH

enters second year at University of Michigan lab in a long range plan to determine safe plumbing uses.

The research evaluation study on extruded thermoplastic pipe being conducted by the National Sanitation Foundation at the University of Michigan's School of Public Health in Ann Arbor, has entered its second year of operation, according to Walter D. Tiedeman, director of the testing laboratory.

Plastics raw materials now undergoing tests to assure complete health safety in water transmission include polyethylene, polystyrene, cellulose acetate butyrate, and copolymers of polyvinyl chloride.

• **PURPOSE.**—Sponsored by the Society of the Plastics Industry, this project is to evaluate the non-toxicity of plastic pipe in the underground transmission of water. The general use of plastic pipe for the carrying of water in permanent water-system installations would be an innovation in this country, and might conceivably lead to the more general use of plastic piping in the plumbing industry at some future date.

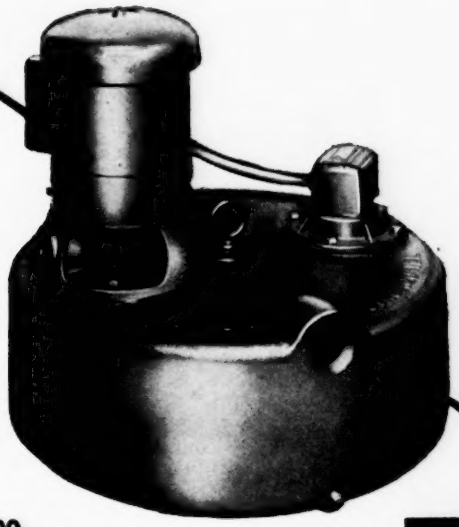
• **COMMITTEE.**—A joint committee of public health officials, plastic pipe extruders and material suppliers has met periodically with foundation officials to coordinate the activities of this research program. The most recent meeting of this committee was held on January 16 to make final plans for the second phase of the study.

• **RECENT RESULTS.**—The work to date, according to Mr. Tiedeman, has involved a study of the possible action of various types of aggressive natural waters in extracting favorable or unfavorable substances from plastic pipe. This was done by immersing cut sections and shavings

(*Continued on page* 136)

LOW PRESSURE SYSTEM
Condensate Pumps

weil Dependable PUMPS



weil TVC Pumps
Low Return Connection
Low Speed, Long Life
Cast Iron Receiver
Single or Duplex
Low Water Line
Capacities 500 to 10,000 Sq. Ft. E.D.R.

For Single Units
Dimensions: 10 gal. receiver
Diameter—21"
Height of return above floor—6⅞"

For Single or Duplex Units
Dimensions: 15 gal. receiver
Diameter—25½"
Height of return above floor—7 3/16"

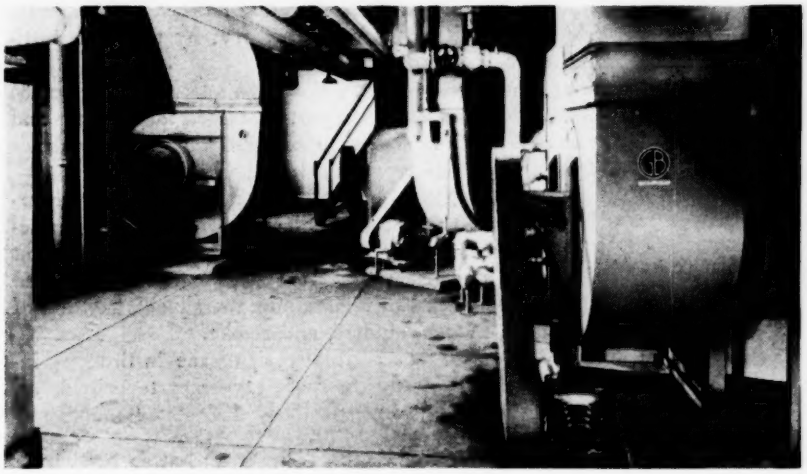
Fig. TVC 126

ASK FOR BULLETIN TVC 300

Available from **JOBBERS' STOCKS**

weil PUMP CO.
1523 N. FREEMONT ST. CHICAGO 22, ILL.

ENGINEERED for Quiet Operation



HOSPITAL QUIET

Equipment Room,
Meadowbrook Hospital,
East Meadow, L. I.
Eggers & Higgins, Architects and Engineers
Guy Panero, Consulting Engineer
Arthur E. Magher Corp.
Heating and Ventilating Engineers

Shown here are four of the thirty-one General Blower Centrifugal Fans recently installed in the 600-bed Meadowbrook Hospital, East Meadow, Long Island. Other General Blower installations have also been made recently in the Hudson River State Hospital, East Harlem and Cumberland Hospitals in New York City, and in the Utica, New York, State Hospital.

General Blowers are widely selected for hospitals because they are rugged blowers, designed to operate with a minimum of impeller noise—a "must" in hospitals and institutions. They have been time-tested, and operate efficiently under the most severe conditions.

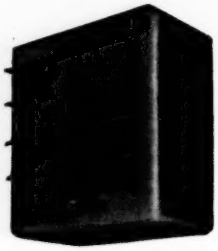
For complete information, write for Catalogue and Engineering Data Manual SC-103.

GENERAL BLOWER CO. 8622 FERRIS AVENUE MORTON GROVE, ILL.

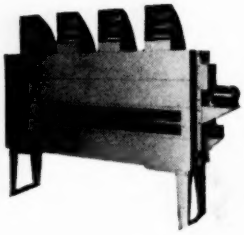
A unit heater for every need from HERMAN NELSON

Vertical shaft propeller-fan type unit heater—*especially suited to buildings with high ceilings—up to 50 feet.*

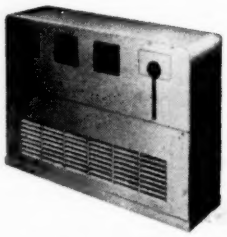
Horizontal shaft propeller-fan type unit heater—*the most generally useful of all space heaters.*



Centrifugal-fan type unit heater—*for efficient heating and ventilating of large industrial spaces.*



De Luxe unit heater—*an attractive, quiet operating unit designed for stores, offices, churches, etc.*



Write for detailed information about any type Herman Nelson Unit Heater to: Dept. HV-3.

AAF herman nelson

American Air Filter COMPANY, INC.

215 Central Avenue, Louisville 8, Ky.

PLASTIC PIPE RESEARCH

(*Continued from page* 134)

from plastic pipe in jars of water under scientifically controlled conditions. As a result, a panel of experts has been able to determine the effect, if any, of exposure to many kinds of plastic pipe on odor and taste of water similar to that found in various parts of the country.

• **FUTURE STUDY.**—Long-range critical studies are about to begin in which various types of aggressive waters are to be exposed for long periods of time to different plastics in self-contained circulating systems of plastic pipe. This water will then be frozen into ice cubes for storage and later use in scientific feeding experiments to assure safety from a health point of view.

• **REPORTS.**—At the conclusion of this research project, which will take at least another year, a comprehensive report will be prepared by the foundation on the test findings, and distributed to state public health officials, industry representatives, and colleges and universities throughout the country.

1937 COAL HEATING ACT

found restrictive by Colorado's State Planning Commission; suggest repeal of law on state buildings.

In a report submitted by Colorado's State Planning Commission to the State Legislature, repeal of a 1937 act requiring all state institutions to heat with coal was recommended. In doing so, the report stated that natural gas and fuel oil are major natural resources of Colorado, along with coal, and are therefore entitled to equal consideration for use as a heating fuel by the state institutions of Colorado.

• **FINDINGS.**—Drafted following a public hearing on the issue, the commission's report contained the findings and recommendations based upon testimony and evidence from institutions represented at the hearings.

• **HANDICAPPED.**—All institutions involved in the hearing contended they are handicapped by the legal restriction preventing them from installing standby equipment for use in a coal shortage. Most of the institutions stressed the additional cost of maintaining their plants because of coal dust, fly ash, cinders, and smoke.

• **SPACE PROBLEM.**—Virtually all of the institutions indicated a lack of storage space necessary to provide an adequate stockpile of coal. They also stated that deterioration of the coal makes large stockpiles uneconomical, although several institutions said they desired to convert to another fuel only as a standby method in case of a coal strike or other emergency.

• **WARNING.**—The coal industry warned that natural gas may be depleted in the future and that institutions would then have to reconvert to coal.

• **INCREASE.**—The commission found that natural gas production has increased five times since the act was passed in 1937. It also noted that crude oil production has increased about 20 times. The Commission declared that no other state among the 48 has a restrictive law similar to Colorado's coal heating act.

. . . FROM

HERMAN NELSON

IN the church shown above, 30 Herman Nelson De Luxe Unit Heaters maintain comfortable temperatures for all services. These versatile units are equally effective for heating stores, offices, markets, display rooms and similar buildings where compact, attractive, quiet-operating heating units are needed.

There are eight models of these unit heaters available for floor, wall, ceiling or recessed installation. All models have an improved "combination type" heating element suitable for either steam or hot water operation. The De Luxe Unit Heater cabinet contains modern styling obtained through superior designing. The absence of projecting parts and its rounded ends contribute to its graceful appearance. The unit is finished in satin-smooth, tan, baked enamel so that it enhances the setting in any application.

Herman Nelson Unit Heaters are ahead of the field because constant engineering development and research plus functional design have earned this position—the result of 45 years of experience in the production of heating and ventilation equipment.

ALUMINUM CENTRIFUGAL FAN WHEELS have slow tip speeds for quieter operation.

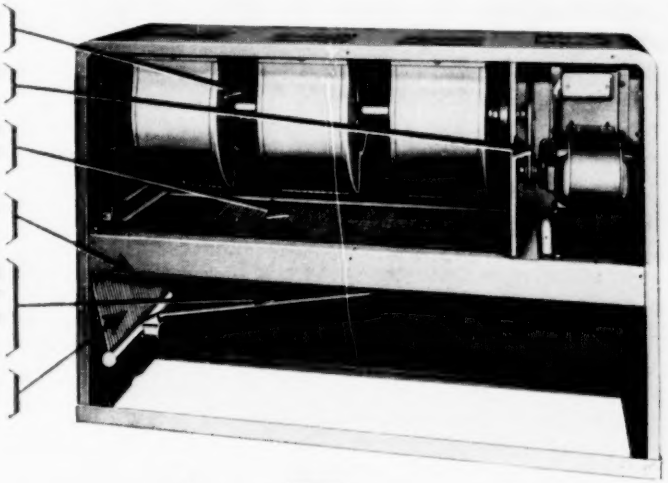
ADJUSTABLE PULLEY permits varying performance to meet exact requirements of job.

CONTINUOUS, NON-FERROUS FINS are formed with extra wide flange to provide efficient contact between expanded tubes and fins.

LOOP in each tube of heating element absorbs difference in expansion and contraction between individual tubes.

PATENTED, EXTRA HEAVY, RED BRASS STAY TUBE maintains proper relationship between headers without increasing strain on loops and allows entrained moisture to drain directly from supply to return header.

ENTIRE TUBE AND LOOP is fabricated of red brass with no connecting joint to weaken construction.

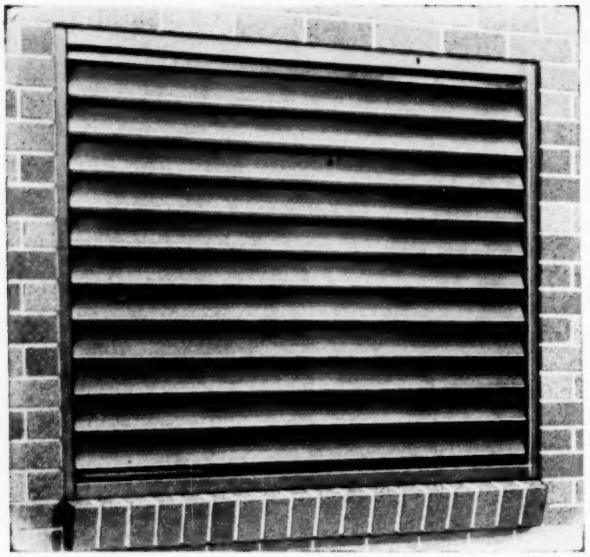


AAF herman nelson

American Air Filter

COMPANY, INC.

215 Central Avenue, Louisville 8, Ky.



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weather-tight louver units tailored to fit any wall opening—*no premium cost*

The conveniently wide size variation available in Airlouvers virtually gives you custom-made equipment at economical standard costs. It's easy to fill any size wall opening with one or more Airlouver units—in either adjustable or fixed types.

These louvers have excellent appearance and high utility. The percentage of free opening area is as large as possible consistent with complete weather-proofness. Strong formed channel frame construction houses overlapping blades. Several methods of operating are optional. Various types of mounting facilities enable you to make the most suitable installation according to building construction. Write for Bulletin 347 H

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The Swartwout Co.

Roof Ventilators and Ventilating Louvers

POWER PLANT EQUIPMENT • PROCESS INDUSTRY CONTROLS

• Latest developments in the distribution, utilization, economic, and hygienic aspects of anthracite will be subjects for the 11th annual Anthracite Conference set for May 7 and 8 at Lehigh University. The conference is designed to bring engineers, educators, operators, and retail dealers as well as the general public up to date on the technological progress in Pennsylvania's hard-coal industry. Serving as members of the planning committee are representatives of educational institutions, research groups, anthracite operators, and retailers. Speakers will include government officials, manufacturers of heating equipment, safety directors, and mining engineers.

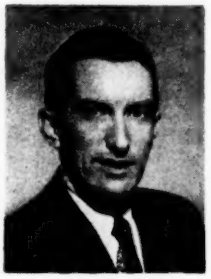
Canadian Degree-Days for January, 1953*

City	January		Cumulative	
	1953	Normal	1952-53	Normal
Calgary, Alta.	1688	1609	4926	5311
Charlottetown, P.E.I.	1246	1463	4033	4328
Crescent Valley, B. C.	976	1352	3898	4631
Edmonton, Alta.	1972	1814	5439	5798
Fort William, Ont.	1702	1807	5335	5622
Grande Prairie, Alta.	2272	1841	6021	6000
Halifax, N. S.	1043	1283	3431	3898
London, Ont.	1169	1336	3842	4013
Medicine Hat, Alta.	1596	1643	4627	5032
Moncton, N. B.	1300	1528	4388	4714
Montreal, P. Q.	1373	1552	4179	4648
North Bay, Ont.	1600	1658	5022	5161
Ottawa, Ont.	1421	1646	5436	4923
Penticton, B. C.	874	1184	3243	3810
Porquis Junction, Ont.	1947	2052	5812	6300
Prince George, B. C.	1277	1615	4657	5372
Quebec City, P. Q.	1457	1696	4593	5207
Regina, Sask.	1817	2037	5684	6373
St. John, N. B.	1184	1417	3893	4386
Saskatoon, Sask.	2018	2027	5838	6276
Toronto, Ont.	1087	1304	3439	3948
Vancouver, B. C.	691	893	2725	3061
Victoria, B. C.	698	815	2624	2725
Windsor, Ont.	1110	1283	3449	3729
Winnipeg, Man.	1904	2111	5577	6316

*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

The Department reports slight revisions on the figures for December, as published in last month's issue. Corrected figures are: Charlottetown, P.E.I., 1153; Victoria, B. C., 689.

GETTING PERSONAL



S. C. Deitrick

S. C. Deitrick *(Refrigerant Piping*, page 95), a native of Richmond, Va., received his B. S. in M. E. from Virginia Polytechnic Institute in 1942. Following graduation he was active in the U. S. Army and served in the Anti-aircraft Artillery and Infantry in the Pacific area until 1946. When mustered out, he had the rank of First Lieutenant.

In 1946 he joined the air conditioning division of Westinghouse Electric Corp. After completing a 4-month student course

(*Continued on page* 140)

Cancer strikes 1 in 5

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Your gifts to the American Cancer Society help guard those you love.

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(*Continued from page* 138)

he was appointed air conditioning service engineer. He served at this post until April, 1952, when he was advanced to service supervisor for air conditioning equipment.

He is a member of the mechanical engineering fraternity of Pi Tau Sigma.

U. F. Earp

Unus F. Earp (co-author, *Design of Hay Drying Systems*, page 77), graduated from Virginia Polytechnic Institute in 1939 with a B. S. in agricultural engineering and obtained his M. S. there in 1950. He was an instructor in agricultural engineering at Virginia Polytechnic Institute from 1939 to 1942. From 1942 to 1945 he was an engineer with the Aircraft Radio Laboratory at Wright Field. In 1945 he returned to Virginia Polytechnic Institute as assistant professor, later to become associate professor and associate agricultural engineer for the Virginia Agricultural Experiment Station.

He is a member of the American Society of Agricultural Engineers and the National Society of Professional Engineers. His research activities have dealt mainly with the development of walk-in-refrigerators for farm use. He is the author of the textbook "Rural Electrification Engineering" and various articles for the technical press. The article in this issue grew out of the accumulated research findings and field experience reported by investigators, designers and operators of hay drying installations in Virginia and a number of other hay producing areas.

V. H. Baker

Vernon H. Baker (co-author *Design of Hay Drying Systems*, page 77), is associate professor of Agricultural Engineering Virginia Polytechnic Institute, Blacksburg, Va. His work there has been devoted to research and development in the application of electricity to agriculture and the processing of agricultural products. He is at present on leave of absence from V. P. I. studying for his Ph.D. degree at Michigan State College under a Rockefeller Foundation graduate fellowship.

Mr. Baker received a B.S. in electrical engineering at Tennessee under the cooperative work plan. After serving two years in the Navy as assistant electronics officer for the Western Naval Districts, he returned to the Fulton Sylphon Co., Knoxville, Tennessee, where he was assistant project engineer. From here he re-entered Tennessee and received a B.S. in agricultural engineering and later M.S. from Michigan State College.

He is author or co-author of more than 20 technical and popular articles on the application of electricity to agriculture and the processing of agricultural products. He is co-author of the Farm Electrical Equipment Handbook published by the Edison Electric Institute in 1950.

(*Continued on page* 142)

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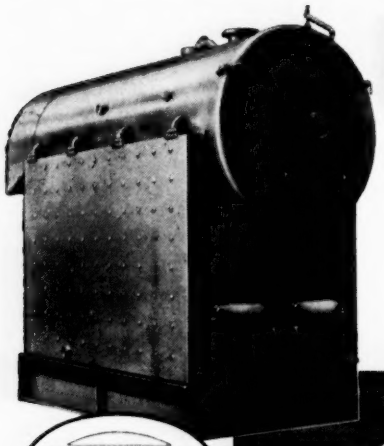
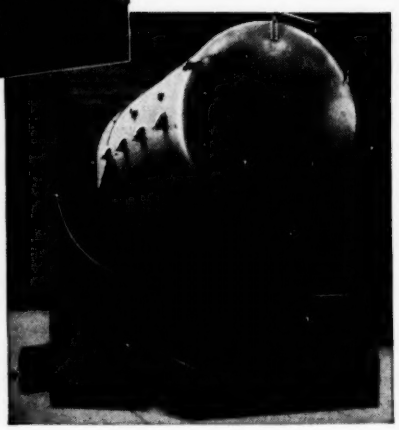


Left: Assembled view of Titusville "Compact" Split Firebox Boiler.



Right: The Titusville "Compact" Split Firebox Boiler with sections opened, suggesting ease of manipulation.

For replacement installations where entrance conditions are not sufficient for the standard boiler, Titusville "Compact" Steel Boilers are obtainable in split firebox design. This practical expedient permits passage of the boiler in unit sections through narrow openings, with easy reassembly. Send us your replacement problem, and let us recommend the best solution for you! Request Bulletin Form C-7959 for Clearance Dimensions.

THE TITUSVILLE IRON WORKS COMPANY
A division of Struthers Wells
Representatives in Principal Cities
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(*Continued from page* 140)

He is a registered professional engineer, member of National Society of Professional Engineers, Va. SPE, ASAE and AIEE and the Volunteer Naval Research Reserve.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

INSTRUMENT SOCIETY MEETING—Sixth annual Regional Meeting of the Instrument Society of America, at the Hotel Statler, New York, N. Y. Richard Rimbach, 551 5th Ave., New York 17, N. Y. . . . . **FEBRUARY 18, 1953.**

TESTING MATERIALS MEETING—Spring meeting of the American Society for Testing Materials, at the Hotel Statler, Detroit, Mich. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. . . . . **MARCH 2-6, 1953.**

CORROSION ENGINEERS EXHIBIT—1953 conference and exhibition of the National Association of Corrosion Engineers, at the Hotel Sherman, Chicago, Ill. Executive secretary of the Association, 1061 M & M Bldg., Houston 2, Texas. . . . . **MARCH 16-20, 1953.**

MICHIGAN ENGINEERING MEETING—Annual meeting of the Michigan Engineering Society, at the Kellogg Center Hotel on Michigan State College Campus, East Lansing, Mich. Joseph E. Wilbur, executive secretary of the Society, Rackham Memorial Bldg., Detroit 2, Mich. . . . . **APRIL 10-11, 1953.**

MASTER PLUMBERS CONVENTION—71st annual convention and exposition of the National Association of Master Plumbers, at Municipal Auditorium, Kansas City, Mo. Oliver F. Erickson, Secretary-Treasurer, National Association of Master Plumbers of the U. S., Inc., 1016-20th Street, N. W., Washington, D. C. . . . . **MAY 6-9, 1953.**

MATERIALS HANDLING EXPOSITION—5th National Materials Handling Exposition, sponsored by The Material Handling Institute, at Convention Hall, Philadelphia, Pa. A series of conferences to be held by the American Materials Handling Society concurrently with the exposition. Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. . . **MAY 18-22, 1953.**

GAMA MEETING—Annual meeting of the Gas Appliance Manufacturers Association, at The Greenbrier Hotel, White Sulphur Springs, West Va. H. Leigh Whitelaw, managing director, 60 E. 42nd St., New York N. Y. . . . . **MAY 20-22, 1953.**

OIL HEAT EXPOSITION—1953 Eastern Biennial Exposition of Oil Heat, sponsored by Oil Heat Institute of New England, at the Hotel Statler, Boston, Mass. F. M. Beckwith, secretary of the Institute, 839 Beacon St., Boston 15, Mass. . . . . **JUNE 2-5, 1953.**

NDHA MEETING—44th annual meeting of the National District Heating Association, at Lookout Mountain Hotel, Chattanooga, Tenn. John F. Collins, secretary of the Association, 827 N. Euclid Ave., Pittsburgh 6, Pa. . . . . **JUNE 9-12, 1953.**

TESTING MATERIALS MEETING—Annual meeting of the American Society for Testing Materials, at the Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. . . . . **JUNE 21-25, 1953.**

ASRE MEETING—Spring meeting of the American Society of Refrigerating Engineers, at the Lake Placid Club, Lake Placid, N. Y. M. C. Turpin, secretary of the Society, 40 W. 40th St., New York, N. Y. . . . . **JUNE 27—JULY 1, 1953.**

INSTRUMENT EXHIBIT—8th National Instrument Conference and Exhibit of the Instrument Society of America, at the Sherman Hotel, Chicago, Ill. John McCaffery, assistant executive secretary of the Society, 1319 Allegheny Ave., Pittsburgh 33, Pa. . . . . **SEPTEMBER 21-25, 1953.**

AGA CONFERENCE—Annual conference of the American Gas Association, at Kiel Auditorium, St. Louis, Mo. Secretary of the Association, 420 Lexington Ave., New York, N. Y. . . . . **OCTOBER 26-28, 1953.**

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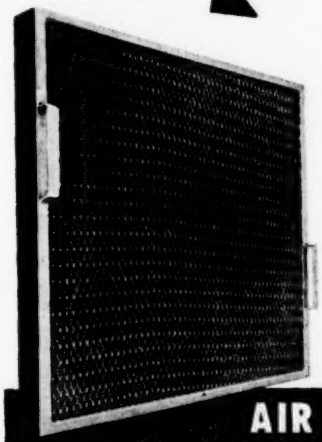
Lower Maintenance Costs



You can be sure of better air filtration with AGITAIR "FM" permanent, cleanable filters. Scientifically designed to filter with greater efficiency at 432 fpm, Two FM's do the work of three conventional type filters . . . 1/3 less space required . . . fewer units to be installed . . . fewer units to service . . . overall installation and maintenance costs reduced to a minimum.

Write for Your Cost Comparison Chart

AIR DEVICES INC.

17 East 42nd St. • New York 17, N. Y.
Filters • Diffusers • Exhausters

Why Waste Wind Power?

the WESTERN ROTARY continues to exhaust during wind lulls by kinetic energy.

Lifetime guaranteed bearings—bearings that stay in alignment. Both bearings mounted on same axis. Long-lasting metallic-leafing paint finish on durable galvanized steel. Clean, low modern silhouette, completely functional. Throat sizes 6" thru 48" . . . Order today from your wholesaler. Write for prices, specifications, other information. In 1952 Sweet's, A.E.C., Heating, Ventilating & Air Conditioning Guide.

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Kno-Draft recommends Alnor VELOMETER for Precision Air Flow Readings

Ask The W. B. Connor Engineering Corporation how to balance an installation equipped with their Kno-Draft diffusers, and they'll tell you . . . measure the *actual* air delivery—precisely and quickly—with an Alnor Velometer.

Balancing a Kno-Draft equipped installation is a fast and accurate process when using an Alnor Velometer. A few simple readings of the instrument and a twist of the wrist are all that is required to adjust the air flow to the desired amount.

The Velometer is the *only* instantaneous, direct-reading air velocity meter—accurate in all ranges, from high to low—compact, portable, easy to understand and use. Wide assortment of jets and fittings makes this precision instrument ideally suited for all air velocity measurement.

For your air measurement needs, get an Alnor Velometer. You'll save time and money wasted in balancing air distribution on your next installation. If you'd like a copy of the instructions on balancing Kno-Draft diffusers with the Alnor Velometer, just send the coupon below.

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Room 514, 420 N. LaSalle St.
Chicago 10, Ill.

☐ Send Kno-Draft Balancing instructions
☐ Send Velometer Bulletin 2448-G

Name.....

Company.....

Address.....

City.....Zone.....State.....

Alnor PRECISION INSTRUMENTS FOR EVERY INDUSTRY

CONVENTION PAPERS

(Continued from page 86)

Test results indicated that an increase in the amount of air being circulated during winter heating caused a decrease in temperature variations within the room but did not cause excessive air motion in the occupied zone. This fact might make it possible to successfully use the same air flow rate for year-round air conditioning—that is, both summer and winter.

Other conclusions reached were: Free openings were unsatisfactory as high sidewall supply outlets for summer cooling; the location of the return air intake had only a localized effect on the room air distribution; at the same outlet velocity, the air motion in the occupied zone was much greater during cooling operation than during heating; vertical vane settings of the supply outlets had a great influence on air distribution during cooling, but only a small influence during heating; horizontal vane settings of the supply outlets affected the air distribution during cooling but not during heating.

Floor Panel Control Systems

A two-year study was made on floor radiant heating systems in two factory buildings and a residence. A report on this study was prepared by Prof. A. B. Algren of the department of mechanical engineering, University of Minnesota, and E. F. Snyder, Jr., supervisor of products application, and J. S. Locke, sales manager, both with the commercial division, Minneapolis-Honeywell Regulator Co. This report was made public in a paper that was read by Mr. Snyder.

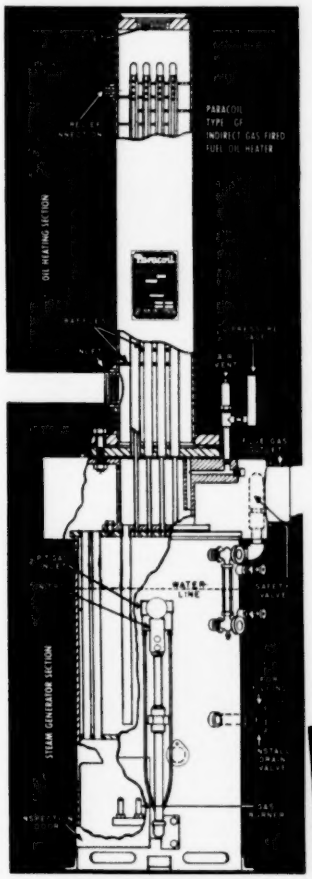
The purpose of the research program was to determine, from actual investigation in the field, the optimum method of control for each basic type of heating panel installed in various types of structures having varying percentages of glass areas. This study was limited to three types of construction which included a general office in a factory building (heavy floor panel, heavy building constructcion, large glass area), a factory area of an industrial plant (heavy floor panel, light building construction, large glass area) and a residence (heavy floor panel, light building construction, small glass area).

The data collected, while not complete, indicates the importance of the proper design and installation of the basic heating systems.

The location of an outdoor thermostat is also of vital concern and the most effective location cannot be categorically stated for any installation until consideration has been given to the type of construction and the local climatic conditions. Where exposed, wall surfaces have a high percentage of glass area, the location of the outdoor thermostat for sensing solar effects is, therefore, especially important.

One way to achieve stable space temperature in buildings of light construction was said to be the continuous operation of the circulating pump, regardless of outside air temperature fluctuation.

A control system which varies the boiler water temperature upward or downward a predetermined amount, in accordance with outdoor temperature variations, permits more desirable stable control of the heat supplied to the space than would a control system using a constant boiler water temperature setting.



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INDIRECT GAS FIRED FUEL OIL HEATER

A RADICALLY NEW APPROACH TO THE PROBLEM OF ADEQUATE OIL PREHEATING UNDER ALL OPERATING CONDITIONS!

The Type "GF" Oil Heater is an integrated self-contained steam vapor generating exchanger using gas as its primary heat source.

However, the gas flame does not come in contact with the tubes containing the fuel oil. Instead, vapor from the lower steam generating section does the actual oil heating!

APPLICABLE TO ALL TYPES OF OIL FIRED APPARATUS!

As it is not dependent upon the unit it is servicing for the means of heating the oil, the Type "GF" Heater can be applied to any oil fired apparatus, be it a steam or hot water boiler, a process oven, a dryer or a kiln!

A COMPLETE SOLUTION TO THE OIL-IN-BOILER PROBLEM!

As the Type "GF" Heater is in no way connected to the steam or water space of any boiler it may be serving, there can be no possible contamination of the boiler heating surfaces in the event of an oil leak in the heater.

CHECK THESE FEATURES!

Completely factory assembled • Easy to install anywhere, even outdoors • Requires only minimum of floor space • Economical to operate • Wide range of oil heating capacities • Burns any specified type of gas fuel High oil temperatures at all times • Operation unaffected by normal variation in viscosities of oils being heated • Reduces oil consumption through improved fuel combustion.

THE PERFECT HEATER FOR:

- Low temperature forced hot water heating systems on No. 6 oil.
- Plants with starting difficulties after week end shutdowns.
- Supplementing inadequacies in present oil preheating systems.

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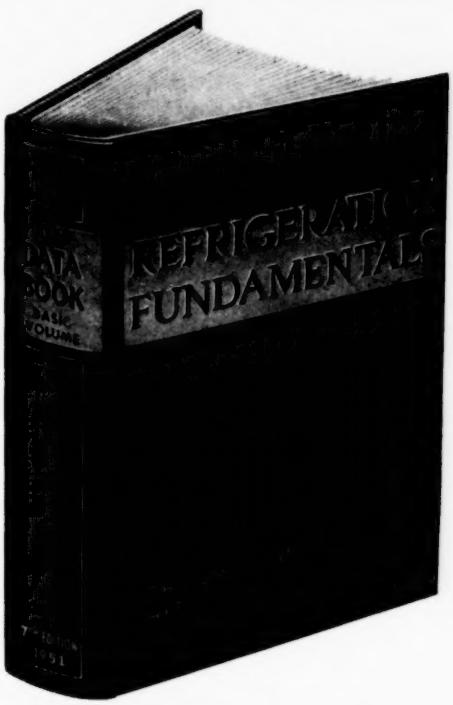

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The 1951 BASIC VOLUME of the ASRE Data Book is an authoritative source of practical working data in convenient form. If you design, install, or operate refrigeration or air conditioning systems, you will find page after page of valuable information in this comprehensive Data Book.

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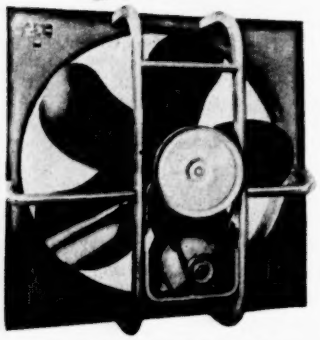

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For factories, mills, theatres, schools, hotels and churches. Features belt drive with ball bearing motor and fan shaft. Sizes from 24" to 72".

STEP-UP OUTPUT and quality of workmanship, reduce industrial accidents and employee fatigue with proper ventilating and cooling equipment. CHELSEA Fans remove excessive heat, fumes, dirt, dust and grit, also dead stale air. 30 models, in over 200 sizes, are available, and each fan or blower is especially engineered and tested for its recommended applications. All ratings are certified by P.F.M.A. test methods to insure proper performance. Check on your ventilating requirements, now.

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ABSTRACTS AND REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

BODY TEMPERATURE

Of interest to research workers and others concerned with body temperature is the book Body Temperature, Its Changes With Environment, Disease and Therapy, by Dr. W. A. Selle, Professor of Biophysics and Physiology, University of California Medical School, Los Angeles, Calif. This interesting examination of the subject goes into the question of both heat production and heat dissipation in the body, integrated temperature control, neural mechanisms of temperature regulation, internal disturbances of temperature regulation, environmental disturbances of heat regulation, and physical allergy.

Body Temperature, Its Changes with Environment, Disease and Therapy by W. A. Selle, limp binding, 5½ x 8½ inches, 112 pages. Published by Charles C. Thomas, 301 East Lawrence Avenue, Springfield, Ill. Price, $3.50.

ECONOMICS OF NATURAL GAS IN TEXAS

Comprehensive, factual information regarding the natural gas industry is presented in Economics of Natural Gas in Texas by Dr. John B. Stockton and Richard C. Henshaw, Jr., with the Bureau of Business Research, The University of Texas, and Richard W. Graves, instructor of business statistics, The Tulane University of Louisiana.

Although this study emphasizes the place of Texas natural gas in the over-all natural picture, it will be of interest to any person concerned with the economic problems of energy sources in the world. To bring out the supply and demand relationships which exist between natural gas and other fuels, there are data on oil, coal, water power and atomic energy.

In addition to presenting economic information, an effort has been made by the authors to include sufficient description of the technology to provide a better understanding and appreciation of the economic problems.

The text has been divided into eleven chapters which include background notes to the natural gas study; utilization of natural gas; employment of natural gas liquids; natural gas production; natural gas reserves; transportation of natural gas; taxation of the Texas natural gas industry; public control of the Texas natural gas industry; conservation; competition among fuels, and summary.

Economics of Natural Gas in Texas, by J. R. Stockton, R. C. Henshaw, Jr., and Richard W. Graves. Cloth bound, 6 x 9 inches, 316 pages. Published by the Bureau of Business Research, College of Business Administration, The University of Texas, Austin, Tex. Price, $5.

• • •

GAS FLOOR FURNACES—The Commodity Standards Division of the U. S. Department of Commerce has issued a revised edition of the Commercial Standard for Gas Floor Furnaces which applies to natural-draft gas floor furnaces of the gravity circulating type. It includes construction and installation requirements and has data re-

(*Continued on page* 148)

REGARDLESS OF SIZE . . .

CYCLOTHERM GIVES YOU STEAM AS YOU NEED IT

with CYCLONIC COMBUSTION!

Cyclotherm Steam Generators means *Quick Steam* when called for. This reduces fuel consumption during "coming up" periods and permits continuous, quick adjustment to load changes. The Cyclotherm Boiler is able to deliver steam faster because of its extremely high heat transfer and the fact that it has much greater water circulation since the combustion chamber is radiating heat evenly in all directions and along its entire length.

If your steam requirements have a tendency to change at different times of the day, the most economical and efficient boiler you can install is a Cyclotherm.

REMEMBER—Full power operation from a cold start in 15 to 20 minutes. Savings up to 50% on maintenance. Great fuel operational savings.

Boilers are designed for oil or gas operations from 18 thru 500 h.p., 15 to 200 lbs. operating pressure.

The Cyclotherm meets all state requirements and is built in accordance with A.S.M.E. and National Board Standards and bears the label of Underwriters Laboratories, Inc.

Write today for latest descriptive folder, "All Your Questions Are Answered by Cyclotherm."

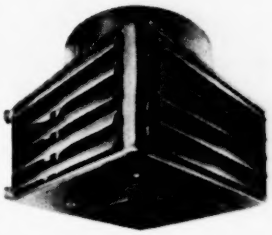
CYCLOTHERM STEAM GENERATORS

DIVISION UNITED STATES RADIATOR CORP.

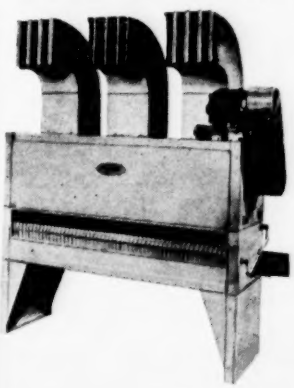
There's a bonus built into this Carrier heater

Good looking, quiet, rugged, this Carrier propeller-fan type horizontal discharge Unit Heater is ideal for a wide variety of applications, delivering warmed air from heights of 15 to 18 feet. It's available in 10 sizes, 21,000 to 200,000 Btu's. For steam or hot water. ***And there's a bonus.*** Its single-row Aerofin heating coil with widely spaced fins offers less air resistance than ordinary heaters, makes cleaning much easier. Carrier design gives you quicker, more efficient, cleaner heat. Carrier Corporation, Syracuse, N.Y.

Any size space can be heated economically with Carrier heating equipment



Carrier propeller-fan type Unit Heaters. Besides the horizontal model, there's a four-way Directed-flo vertical model (left) which gives quick heat from higher ceilings, discharges warmed air in 4 directions, for steam or hot water, in 7 sizes from 82,000 Btu's. And a gas-fired model with one-piece heat exchanger and combustion chamber of Aluminized Steel, AGA approved for all gases, in 7 sizes from 70,000 Btu's (there's a duct type gas-fired model, too).



Carrier blower type Heat Diffusers. For heating and ventilating larger enclosed areas. Floor, wall or ceiling mounted, sectionalized for easy rearrangement. In 6 sizes to 2,390,000 Btu's per hr. at 2-lb. steam. Air handling capacities to 31,000 cfm. Steam or hot water.

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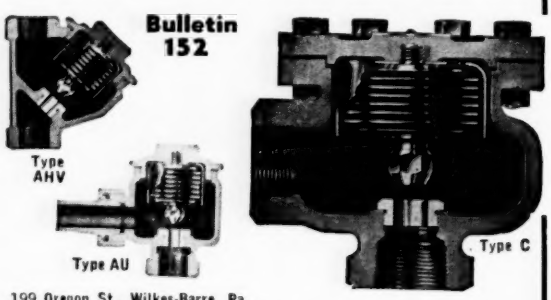
NICHOLSON TRAPS

SAVE CAR OF COAL WEEKLY

Following replacement of all steam traps, of various makes, with Nicholson units, an Eastern college reports "an average coal saving of 1 carload per week besides much better heat distribution". Credit is given the higher and more even temperatures which Nicholson traps effect. See why large industrial and institutional steam users are increasingly standardizing on Nicholsons. 5 types; for heat, power, process; sizes ¼" to 2"; press. to 250 lbs.



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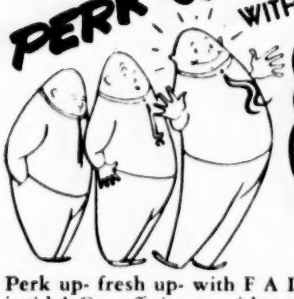
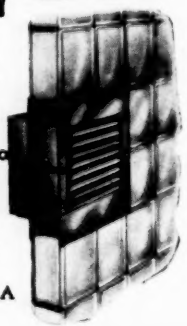
TRAPS · VALVES · FLOATS

YOUR PLANT WILL PERK UP WITH FRESH AIR INSIDE!



and it's so easy with MUCKLE FRESH AIR INTAKES

Perk up- fresh up- with F A I- fresh air inside! Get efficiency with economy by installing MUCKLE FRESH AIR INTAKES — they'll supply fresh, filtered air to each room and condition your plant for *top* efficiency without the expense of costly distribution ducts. Muckle Intakes contain inverted v baffels to arrest direct blow through, oiled spun glass filters and adjustable closing louvers on inside.



A

Model A fits easily into glass block construction by removing 4 blocks. Model B fits any wall thickness. Both models have air opening of 10" x 14" and pass 1000 CFM at .0625" static air pressure.

B

Muckle

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For complete information on Muckle Fresh Air Intakes.

MANUFACTURING CO. OWATONNA 3, MINNESOTA

(*Continued from page* 146)

garding sizing, placement, general installation, venting, and gas connections. Commercial Standard CS99-52 on Gas Floor Furnaces—Gravity Circulating Type, Second Edition. Superintendent of Documents, Government Printing Office, Washington 25, D. C. Price, 5 cents.

EARTH HEAT PUMP RESEARCH—Part 3 of Earth Heat Pump Research prepared by Estel B. Penrod, Professor and Head of the Department of Mechanical Engineering, and Raymond C. Thornton, research engineer, the Engineering Experiment Station, College of Engineering, University of Kentucky. It is issued as Bulletin No. 25 and is the third progress report on research in an earth heat pump system installed in the mechanical engineering laboratory. It contains an account of the performance of an earth heat pump operating intermittently on the cooling cycle from July 1 to October 1, 1950. This report of 85 pages has a large number of operating charts and tables. Engineering Experiment Station, University of Kentucky, College of Engineering, Lexington, Ky.

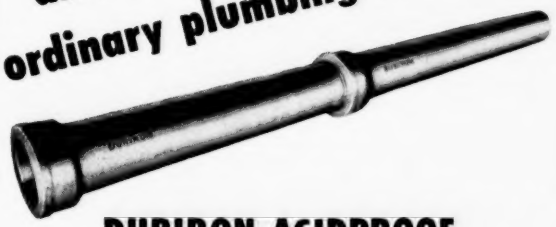
THERMODYNAMIC PROPERTIES OF NITROGEN—The engineering design of plants to separate nitrogen from natural gas requires accurate data on the thermodynamic properties of nitrogen over a wide range of conditions. To provide charts of value to the natural gas industry, researchers at the Institute of Gas Technology, affiliated with Illinois Institute of Technology, have recalculated the usual thermodynamic properties of nitrogen on the basis of more recent fundamental data from the published literature. This information has been issued as IGT Research Bulletin No. 18. It presents the properties in tabular form and as charts of enthalpy vs entropy, and of compressibility factor as a function of temperature and pressure. As a supplement to the bulletin, two separate charts are available printed on heavy paper 22 x 34 inches. These are a Mollier chart for nitrogen, and compressibility chart for nitrogen. These charts are sold separately. The bulletin sells for $3.50. Institute of Gas Technology, Technology Center, Chicago 68, Ill.

FOOD SERVICE EQUIPMENT — The National Sanitation Foundation has published the second in its series on national sanitation standards—this on food service equipment. Besides getting into standards for the actual construction of equipment, there is information regarding the hoods for such equipment. National Sanitation Foundation, Ann Arbor, Mich. Price, 50 cents.

PRESERVATIVE TREATMENT OF POLES—Specifications have been issued for full length, non-pressure preservative treatments of poles by hot and cold submersion processes. Treatments of poles covered by these specifications are: Northern white cedar; western red cedar; douglas fir; western hemlock; western larch; jack pine; lodgepole pine. Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y.

ROLLED STEEL WASHERS—Specifications have been issued by the Transmission and Distribution Committee of the Edison Electric Institute on rolled steel washers. Specifications cover round and square flat, rolled steel washers and square curved rolled steel washers commonly used in overhead line construction. Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y.

The permanent drain pipe installed by ordinary plumbing methods

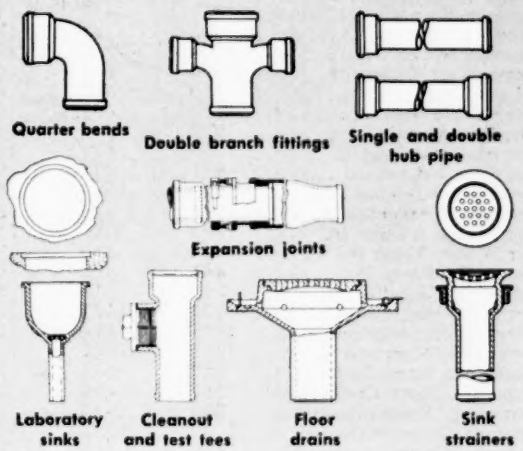


DURIRON ACIDPROOF DRAIN PIPE AND FITTINGS

Duriron is a high silicon iron alloy highly resistant to most commercial acids at practically all temperatures and concentrations. It is not a coating—the entire thickness of the pipe wall is resistant to abrasion and erosion as well as to corrosion.

The labor cost of installing Duriron is the same as with ordinary cast iron soil pipe. Normally the initial cost is the final cost since Duriron will generally outlast the building in which it is installed.

SOME OF THE MORE THAN 60 STANDARD DURIRON FITTINGS



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LOOK FOR THE NAME ON EVERY PIECE

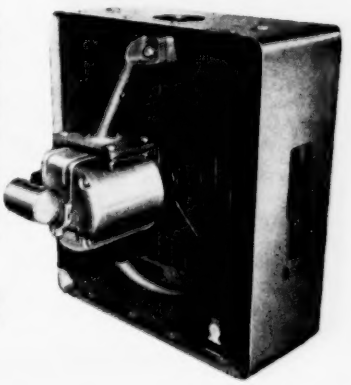
YOUNG
UNIT HEATERS
get Dependable Power

WHEN THE HEAT'S ON . . .

reliable Doerr Motors move it where needed. Typical Doerr heater applications are shown in the cabinet heater above and in the horizontal unit below—reliable performers from the Young Radiator Company line of top quality products.

Among the many features embodied in the Doerr Motor design for heater use is the resilient mounting specifically engineered to hold the motor securely in place during shipment and in all mounting positions. The formed clips prevent axial movement in either direction, while the hooked slots in the base prevent clips from springing outward.

If you have an unusual motor problem please let us hear from you.



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Electric Motors from 1/30 to 5 hp. Standard, or Designed to Your Specifications

Meet Your Special Needs with a Frick Unit Air Conditioner

A drafting room in Utah . . . an ice cream bar in Mississippi . . . a specialty shop in New York . . . each has its particular human comfort problems. All are met with Frick Unit Air Conditioners . . . because they're designed to be adaptable . . . having extra cooling capacity . . . as well as provision for optional winter heating . . . plus record - breaking dependability. • They are applied to each job by experienced refrigerating engineers. You get this superior equipment and superior engineering service only when you install Frick Air Conditioners. Write, wire, phone or visit us: Branches and Distributors in all principal cities.

Two Offices and the Sales Room of the Madison County Dairies, near Jackson, Miss., are Cooled by this 5-hp. Frick Unit.

FRICK CO.
DEPENDABLE REFRIGERATION SINCE 1882
WAYNESBORO, PENNA. U.S.A.

DEGREE-DAYS FOR JANUARY, 1953

(A) Airport readings; (C) city office readings;
(O) Readings at a point on outskirts of city.

HEATING AND VENTILATING'S 25th Year of Publication of Monthly Degree-Day Data

City	January		
	1953	1952	Normal
Abilene, Texas (A)	403	410	326
Albany, New York (A)	1101	1196	1287
Albuquerque, New Mexico (A)	700	800	924
Alpena, Michigan (C)	1219	1271	1431
Anaconda, Montana (C)	(a)	1309	1321
Asheville, North Carolina (C)	700	634	831
Atlanta, Georgia (C)	546	479	682
Atlantic City, New Jersey (C)	753	803	992
Augusta, Georgia (A)	457	371	555
Baker, Oregon (C)	837	1282	1218
Baltimore, Maryland (C)	714	755	955
Billings, Montana (A)	886	1398	1318
Binghamton, New York (C)	971	1106	1268
Birmingham, Alabama (A)	478	422	589
Bismarck, North Dakota (A)	519	1961	1807
Block Island, Rhode Island (A)	876	891	1048
Boise, Idaho (A)	737	1182	1097
Boston, Massachusetts (A)	930	997	1150
Bozeman, Montana (C)	(a)	1430	1403
Buffalo, New York (A)	1038	1122	1240
Burlington, Iowa (A)	1162	1185	(a)
Burlington, Vermont (A)	1241	1361	1429
Butte, Montana (C)	(a)	1405	1309
Cairo, Illinois (C)	735	710	908
Charleston, South Carolina (C)	350	291	487
Charlotte, North Carolina (C)	560	530	725
Chattanooga, Tennessee (A)	587	546	732
Cheyenne, Wyoming (A)	907	1127	1215
Chicago, Illinois (C)	1061	1105	1190
Cincinnati, Ohio (C)	812	780	1017
Cleveland, Ohio (A)	969	1012	1181
Columbia, Missouri (A)	943	953	1110
Columbia, South Carolina (C)	416	377	586
Columbus, Ohio (C)	919	902	1113
Concord, New Hampshire (A)	1153	1284	1349
Concordia, Kansas (C)	1017	1049	1184
Dallas, Texas (A)	429	349	617
Davenport, Iowa (C)	1193	1193	1352
Dayton, Ohio (A)	961	971	1116
Deer Lodge, Montana (C)	(a)	1416	1376
Denver, Colorado (C)	781	927	1079
Des Moines, Iowa (A)	1260	1345	1392
Detroit, Michigan (A)	1062	1098	1252
Devils Lake, North Dakota (C)	1721	1987	1949
Dodge City, Kansas (A)	797	893	1116
Dubuque, Iowa (C)	1311	1418	1442
Duluth, Minnesota (C)	1622	1746	1727
Eastport, Maine (A)	1124	1264	1380
Elkins, West Virginia (A)	884	894	1048
El Paso, Texas (A)	450	482	629
Ely, Nevada (A)	973	1462	(a)
Erie, Pennsylvania (C)	922	1013	1172
Escanaba, Michigan (C)	1303	1417	1550
Evansville, Indiana (A)	837	822	949
Fargo, North Dakota	1690	1967	1815
Fort Smith, Arkansas (A)	677	576	850
Fort Wayne, Indiana (A)	1073	1067	1194
Fort Worth, Texas (A)	404	360	580
Fresno, California (A)	441	606	583
Galveston, Texas (C)	210	117	353
Grand Junction, Colorado (A)	970	1171	1233
Grand Rapids, Michigan (A)	1157	1194	1262
Green Bay, Wisconsin (C)	1369	1492	1538
Greensboro, North Carolina (A)	653	633	772
Greenville, South Carolina (A)	569	498	744
Harrisburg, Pennsylvania (A)	889	938	1088
Hartford, Connecticut (A)	1009	1053	1159
Hatteras, North Carolina (C)	419	469	589
Havre, Montana (C)	1273	1769	1624
Helena, Montana (A)	937	1620	1375
Houston, Texas (C)	233	157	366
Huron, South Dakota (A)	1430	1720	1650
Indianapolis, Indiana (A)	989	981	1128
Jackson, Mississippi (A)	384	331	(a)
Kansas City, Missouri (A)	937	958	1141
Knoxville, Tennessee (A)	622	571	815
La Crosse, Wisconsin (A)	1384	1504	1535
Lander, Wyoming (A)	1021	1348	1436

(a) Data not available.

City	January		
	1953	1952	Normal
Lansing, Michigan (A)	1179	1185	1336
Lewiston, Maine (O)	1137	1259	1452
Lincoln, Nebraska (C)	1199	1227	1311
Little Rock, Arkansas (A)	555	529	719
Livingston, Montana (C)	(a)	1258	1220
Los Angeles, California (C)	157	371	326
Louisville, Kentucky (A)	764	792	939
Lynchburg, Virginia (A)	727	701	856
Macon, Georgia (A)	435	319	549
Madison, Wisconsin (C)	1280	1346	1500
Marquette, Michigan (C)	1318	1398	1500
Memphis, Tennessee (A)	588	542	744
Meridian, Mississippi (A)	540	406	552
Milwaukee, Wisconsin (A)	1216	1293	1383
Minneapolis, Minnesota (A)	1488	1629	1609
Moline, Illinois (A)	(a)	1232	(a)
Montgomery, Alabama (A)	427	320	515
Nantucket, Massachusetts (A)	878	929	1026
Nashville, Tennessee (A)	609	636	812
New Haven, Connecticut (A)	952	989	1110
New Orleans, Louisiana (C)	209	145	332
New York, New York (C)	832	880	1028
Newark, New Jersey (A)	876	898	1083
Norfolk, Virginia (C)	535	559	728
North Head, Washington (C)	622	726	725
North Platte, Nebraska (A)	999	1143	1300
Oakland, California (C)	376	568	527
Oklahoma City, Oklahoma (C)	672	624	865
Omaha, Nebraska (A)	1243	1320	1355
Oswego, New York (C)	1053	1155	1277
Parkersburg, West Virginia (C)	778	802	992
Peoria, Illinois (A)	1125	1163	1283
Philadelphia, Pennsylvania (C)	799	817	962
Phoenix, Arizona (C)	259	399	409
Pittsburgh, Pennsylvania (C)	806	858	1054
Pocatello, Idaho (A)	885	1368	1218
Portland, Maine (A)	1124	1280	1321
Portland, Oregon (C)	505	842	806
Providence, Rhode Island (C)	901	950	1116
Pueblo, Colorado (A)	780	879	1060
Raleigh, North Carolina (C)	521	517	722
Rapid City, South Dakota (A)	1038	1311	1320
Reading, Pennsylvania (C)	857	886	1088
Red Bluff, California (A)	447	711	(a)
Reno, Nevada (A)	755	1198	1042
Richmond, Virginia (C)	654	657	831
Rochester, New York (A)	1058	1149	1252
Roswell, New Mexico (A)	538	592	786
Sacramento, California (C)	404	644	614
St. Joseph, Missouri (A)	1048	1077	1187
St. Louis, Missouri (C)	890	856	1060
Salt Lake City, Utah (A)	784	1170	1110
San Antonio, Texas (A)	278	212	381
San Diego, California (A)	156	321	332
Sandusky, Ohio (C)	972	986	1181
San Francisco, California (C)	324	519	465
Sault Ste. Marie, Michigan (A)	1424	1465	1581
Savannah, Georgia (A)	355	273	409
Scranton, Pennsylvania (C)	972	1057	1172
Seattle, Washington (C)	545	774	781
Sheridan, Wyoming (A)	962	1389	1431
Shreveport, Louisiana (A)	416	327	555
Sioux City, Iowa (A)	1413	1454	1435
Spokane, Washington (A)	832	1281	1172
Springfield, Illinois (C)	993	1028	1181
Springfield, Missouri (A)	841	854	876
Syracuse, New York (A)	1064	1182	1277
Tacoma, Washington (C)	566	805	812
Terre Haute, Indiana (A)	959	967	1070
Toledo, Ohio (A)	1031	1053	1203
Topeka, Kansas (C)	954	999	1135
Trenton, New Jersey (C)	848	879	1014
Utica, New York (O)	1125	1263	1248
Valentine, Nebraska (C)	1128	1387	1370
Walla Walla, Washington (C)	508	1051	989
Washington, D. C. (C)	724	750	970
Wichita, Kansas (A)	846	879	1094
Williston, North Dakota (C)	1511	1841	1805
Winnemucca, Nevada (C)	780	1155	1150
Yakima, Washington (A)	805	1360	1159

(a) Data not available.

Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

Dr. Howell's Clinic at Canton, Miss. Is cooled with a Frick Unit Air Conditioner. Installation by The Munford Engr. Co., Jackson.

Superior Establishments Call for Superior Air Conditioners

You get this extra quality when you buy Frick Units. They're better designed, more carefully built, and are installed by experienced refrigerating engineers. They are honestly rated: by actual comparison, Frick Units deliver more cooling effect per dollar invested.

Frick Unit Conditioners Include Winter Heating Coils when Desired.

Three sizes, 3, 5 and 7½ horsepower. Get the full facts on Frick Unit Air Conditioners — the choice of those who want the ultimate in quality—before you buy. Write

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

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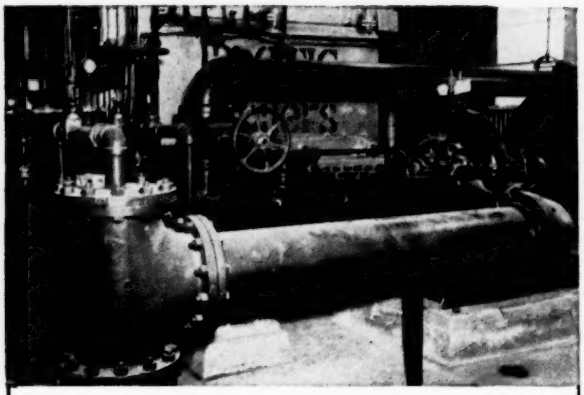
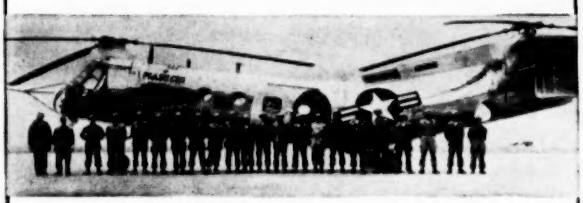
Below: This Duncan Hines Approved Restaurant at Arlington, Va., Uses Two Frick Unit Conditioners.



"K" Fittings in largest helicopter plant

Conspicuous in the above photo are some of our big flanged tees and elbows. You will also see several of our companion flanges and screwed elbows. This is one of the numerous installations of "K" Fittings in the world's largest helicopter plant, that of Piasecki Helicopter Corporation, Morton, Pa.

Plant of Piasecki Helicopter Corporation



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Complete information gladly furnished.

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Combined marketing facilities with Malleable Iron Fittings Company, Branford, Conn.

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AND CUT FUEL BILLS AS MUCH AS 20% TO 30%

In commercial or industrial installations where a burner is used to heat a building containing over 1500 sq. ft. of installed radiation . . . or when 45 tons of coal . . . or 6000 gallons of light fuel oil are used each year, fuel bills can be cut as much as 20 to 30 per cent with a Cleaver-Brooks Hev-E Oil Burner. Here's why:

The Hev-E Oil Burner is designed to save money two ways — it utilizes the heavy, low-cost, high heat No. 5 oil — it saves on the total amount of oil used. Scores of outstanding successful installations prove its economical, efficient, trouble free performance.

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Dept. C, 383 E. Keefe Ave., Milwaukee 12, Wis.

Cleaver-Brooks HEV-E-OIL BURNER

"The Burner Designed to Save You Money"

For Commercial, Industrial, and Institutional Installations

- Burns low-cost, high-heat No. 5 oil
- Low fire starting
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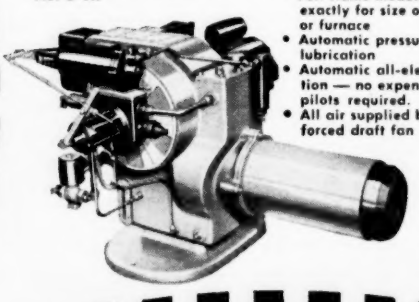
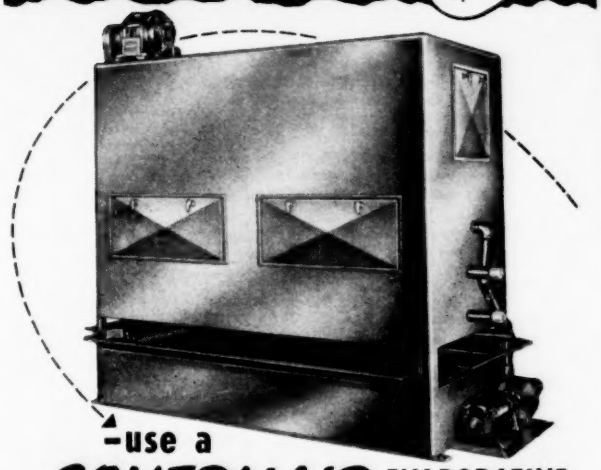
- Automatic pressure lubrication
- Automatic all-electric ignition — no expensive gas-pilots required.
- All air supplied by large forced draft fan



When water is a *Headache...*



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GOVERNAIR EVAPORATIVE CONDENSER

Water supply for air conditioning *can* cause you a lot of trouble. When there's a shortage; when rates are expensive or when sewage and piping are impractical—*water becomes a real headache!*

That's when engineers and contractors alike turn to Governair Evaporative Condensers!

Governair Evaporative Condensers eliminate waste-water disposal problems and pumping costs. And they're engineered to give maximum efficiency and performance at a reasonable cost. Available in sizes from 3 to 100 tons.

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U-01 BRONZE GLOBE VALVE

★ Renewable Composition Disc

Perfect sealing at all times—

A disc for every type of service—

#50—a hard disc for general usage

#52—a rubber disc for cold water valves

#60—a special synthetic disc highly resistant to gasoline, oils and many acids and alkalies.

★ Two Piece Union Bonnet

—Quick, easy disassembly

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★ Radial Seat of Two Piece Union Bonnet

—Leak-proof Body Bonnet Joint

—Rigid alignment of all parts—guaranteed perfect seating all the time.

DART UNION

★ Ground Ball Joint having extra wide seating surfaces

★ Two Bronze Seats, non-corroding, on both sides of the seat

★ Leak-proof without excessive torque because of true bearing surfaces

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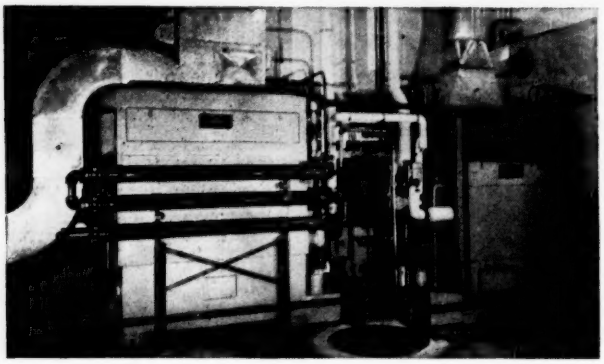
PRECISELY AS YOU WANT IT



NIAGARA CONTROLLED HUMIDITY AIR CONDITIONING

This method removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the leaving air. Heating or cooling is done as a separate function.

The Niagara's Controlled Humidity Method using HYGROL moisture-absorbent liquid is

Best and most effective because . . . it removes moisture as a separate function from cooling or heating and so gives a precise result constantly and always. Niagara machines using liquid contact means of drying air have given over 20 years of service.

Most reliable because . . . the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions.

Most flexible because . . . you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Easiest to take care of because . . . the apparatus is simple, parts are accessible, controls are trustworthy.

Most compact, taking less space for installation.

Inexpensive to operate because . . . no re-heat is needed to obtain the relative humidity you wish in normal temperature ranges and frequently no refrigeration is used to remove moisture.

The cleanest because . . . no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

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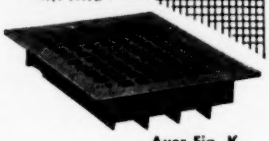
Sales Engineers in Principal Cities of U. S. and Canada

LEADING CONTRACTORS prefer Auer "K" ALL STEEL REGISTERS for walls or ceilings—

HERE'S WHY:



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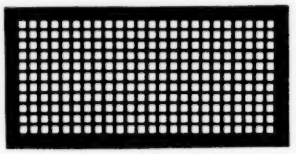
2. *Neater Appearance*—Inconspicuous flush-wall installation. Plain lattice pattern. Stainless steel, bronze, aluminum, chromium or prime finish faces for painting to match any decorative scheme.
3. *Easier Maintenance*—Flat surface cleans as easily as surrounding wall. Trouble-free working mechanism.
4. *Other Features*—Patented spring-lock louvre adjustment—easy to operate, non-slipping, positive. Keylock, pole or pulley operated. Available with multiple units behind a single, continuous face. Auer perforated grilles with matching lattice pattern available in any size.

Auer Fig. KP Pulley-Operated Register



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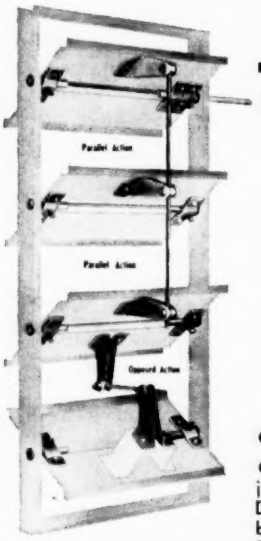

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Specify and use the . . .

"DURO BLADE KIT"

PRECISION-ENGINEERED DAMPER HARDWARE

- Produces highest quality damper
- Blade openings individually adjustable. Automatic, self-centering DURO-BRACKET assures smooth, non-binding, quiet operation. Self-oiling DURO-BUSHINGS "tap-fit" into frame.
- Complete adjustability, even after installation, cuts time and cost. Allows use of unskilled labor.
- Sturdy, corrosion resistant materials used throughout. Can be used on heaviest dampers.

For Samples—Prices write **Dept. E**

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THE IMPROVED WATROLA "160"

HOT WATER BOILER provides extreme heating efficiency at low cost for many wet heating installations, as well as for *booster service*, or *volume hot water heating* in hotels, restaurants, apartments, hospitals, self-service laundries, auto washing, swimming pools, showers, etc. Send for descriptive literature.

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BOOSTER SERVICE (180° SANITARY WATER)

ADVANTAGES AND FEATURES include: Instant response to heat demands, because of patented heat-absorption method; all-copper heat exchanger; 160,000 B.t.u., yet only 45½" high, 21¼" wide and 10½" deep; requires only a 6" vent; A.G.A. approved for natural and manufactured gas; shipped completely assembled, ready for installation.

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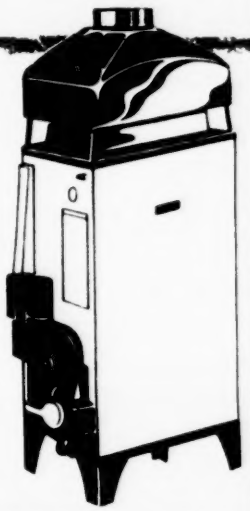

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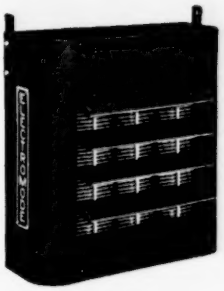

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Suspension Type Models, 10,000 to 45,000 watts. For permanent installation where large areas are to be heated and for auxiliary heat in hard-to-heat areas. Adjustable louvers for directing fan-circulated heat where desired.

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Combination Portable and Suspension Type Models, 1500 to 7500 watts. Smaller heaters may be plugged in temporarily wherever heat is needed or mounted permanently on swivel-type brackets. Adjustable louvers for directing fan-circulated heat where desired.

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Completely SAFE!

Only Electromode has the sealed-in CAST-ALUMINUM HEATING ELEMENT. No danger of fire, shock or burn. Automatic safety switch prevents overheating.

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This modern design Electromode Wall-Type Heater has built-in thermostat for individual room temperature control. Fan-circulated heat is distributed by Down-Flo principle—at floor level. Easy to install in new building or remodeling. Handsome silver grey hammertone finish. Available in 1500 to 4000 watts.

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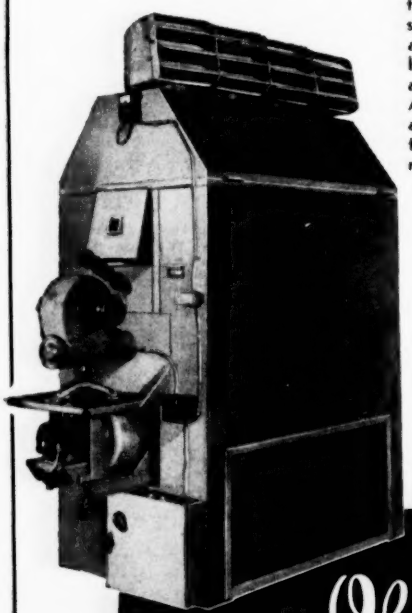

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Gas, Oil, Coal or Dual Gas and Oil
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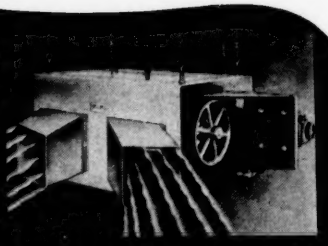

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FOR HEAVY-DUTY HEATING IN FACTORIES, WAREHOUSES, OFFICES

Ceiling mounted CHROMALOX Electric Blower-Type Heaters are your quick, easy answer to space heating! Twin centrifugal fans, driven by a 3-phase motor, distribute warmth evenly over large areas. Air ducts can be used to convey heated air to desired locations. Automatic thermal cutout assures protection against overheating. 51,180 to 136,480 BTU output per hour.

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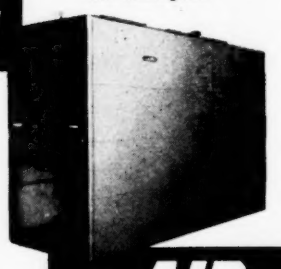
ELECTRIC HEAT FOR MODERN INDUSTRY

EVERYTHING IN AIR CONDITIONING
usAIRco

Refrigerated Kooler-aire with Heating Coil



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DEPT. HV 353

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UNITED STATES AIR CONDITIONING CORP.
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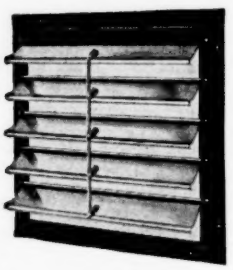

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Front View (Open)

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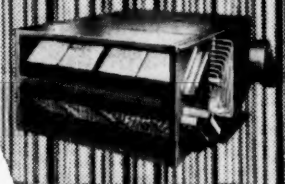

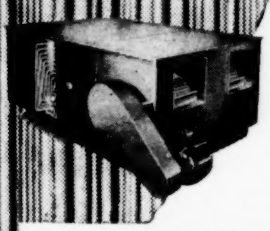

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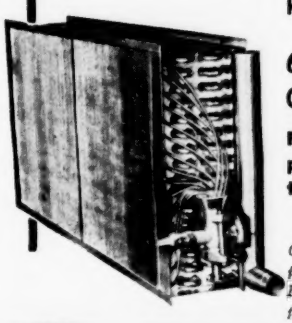

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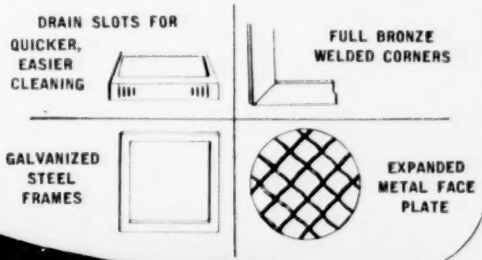
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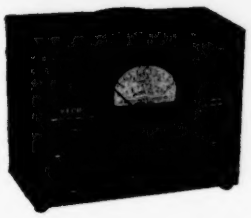

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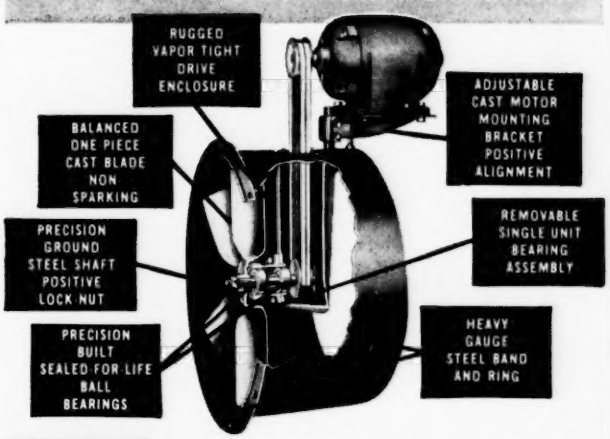
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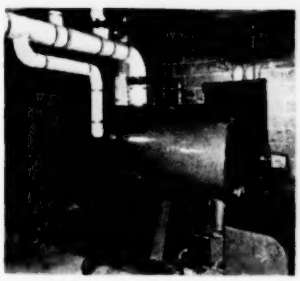

Above—Entrance to the new Essex County Colored School, Tappahannock, Va., which is the first unit of a consolidated school unit.

Left — Model SPL-50-5 Steam-Pak Generator, manufactured by York-Shipley, Inc., York, Pa., installed in school boiler room. Space provided for two more boilers when additional units of school are added.

TAPPAHANNOCK, VA.— The new $205,199 Essex County Colored School, which was opened here last fall, is heated by a 50-hp. low pressure Steam-Pak Generator which was selected because it offered three-way cost savings.

"The Steam-Pak Generator was selected because original building costs were reduced by omitting the stack, installation costs were lower because of simplicity of hook-up, and, most important, for economy of operation." J. Henley Walker, Jr., Architect of Richmond, Va., reported.

The new school building is the first unit of a consolidated school and includes 10 classrooms, library, general purpose and cafeteria room, kitchen, office suite and clinic. Additional units planned for the school are six more elementary classrooms and high school facilities. Space has been provided in the boiler room for additional steam generators.

The heating system was installed by Virginia Plumbing & Heating Co., Inc., Richmond, Va., for Howard Mitchell, Richmond, Va., General contractors. The Steam-Pak Generator was sold by Pelouze Sales Co., Hillcrest Bldg., Richmond 19, Va., distributor.

Other new Virginia schools which have installed Steam-Pak Generators, according to Henry L. Pelouze, manager of Pelouze Sales Co., include Carter G. Woodson Elementary School and Hopewell High School Gymnasium, Hopewell; Walker-Grant and James Monroe High Schools, Fredericksburg, and Dunbar, Booker T. Washington, and Bankhead Magruder Schools, Newport News.

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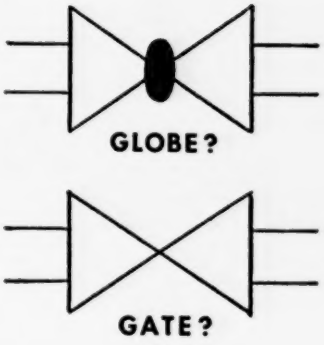

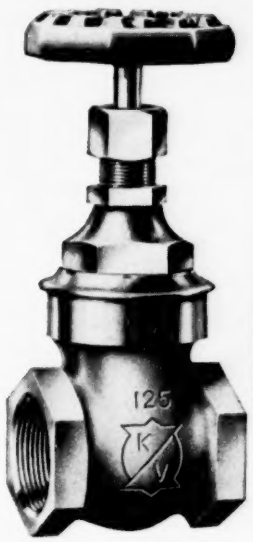

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The accompanying data on heating and cooling media other than water are largely from a paper by D. G. Lewis presented before the Institution of Heating and Ventilating Engineers (Great Britain). To these data have been added those on heat transfer oils.

Brine

The introduction of certain salts into water alters the boiling and freezing point of the solution in a specific manner according to the concentration of salt. It is interesting to note that the freezing point of water is gradually lowered as salt is added up to a concentration above which the freezing point rises and may eventually be higher than that of water. The actual boiling and freezing points depend on the nature of the salt as well as the concentration of salt in the solution. Calcium chloride is a salt commonly used in brine solutions for heat transfer purposes.

Table 1 shows the boiling and freezing points of calcium chloride solutions.

The characteristics of calcium chloride brine are such as to make it attractive for cooling systems but less attractive for heating systems.

Glycerine

Glycerine can be readily handled for both heating and cooling applications. In high concentrations it has a high boiling point. Both the boiling point and freezing point are lowered when glycerine is diluted with water, the freezing point reaching a minimum of —51F when the water content is about a third of the weight of solution. Table 2 shows the characteristics of aqueous solutions of glycerine.

Glycol

Ethylene glycol has some of the characteristics of glycerine. It is heavier than water, has no marked corrosive effect on iron and steel. On some other metals and alloys it has a marked corrosive effect which can be modified by inhibitors. It should not be used with zinc or galvanized iron. Characteristics of ethylene glycol solutions are shown in Table 3.

Aroclor

Aroclor is a trade name applied to a group of chlorinated biphenyls. Aroclor 1248 has a boiling point of 644F and a freezing point less than 20F. Its specific heat at 86F is .29 and increases to .44 at 248F. Viscosity at 86F is 112 centipoises.

TABLE 1—BOILING AND FREEZING POINTS OF CALCIUM CHLORIDE SOLUTIONS

Concentration, Per Cent, Weight	Specific Gravity at 60F	Freezing Point, F	Boiling Point, F
40	1.410	+56	248
30	1.295	−51	237
20	1.186	0	221
10	1.087	+22	214

TABLE 2—BOILING AND FREEZING POINTS OF AQUEOUS SOLUTIONS OF GLYCERINE

Concentration, Per Cent, Weight	Specific Gravity at 60F	Freezing Point, F	Boiling Point, F
98.2	1.261	+56	554
95.0	1.253	+46	332
90.0	1.240	+29	281
80.0	1.213	−5	250
70.0	1.185	−38	237
66.7	1.178	−51	234
60.0	1.157	−30	228
50.0	1.129	−9	223
40.0	1.102	+4	219
30.0	1.075	+15	217

Dowtherm

Dowtherm A is a trade name of diphenyl and diphenyl oxide, produced as a heating medium at high temperature, particularly for use in saturated vapor form. It can be used freely with the common construction metals and has a scouring effect on rust or welding scale, is chemically stable over the whole range of temperature from freezing to boiling, and under pressure can be heated up to 650F without deterioration. At

TABLE 3—BOILING AND FREEZING POINTS OF AQUEOUS SOLUTIONS OF ETHYLENE GLYCOL

Concentration, Per Cent, Volume	Specific Gravity at 60F	Freezing Point, F	Boiling Point, F
100	1.113	+10	386
90	1.105	−17	288
80	1.098	−45	260
70	1.088	−47	245
60	1.078	−54	235
50	1.061	−34	229
40	1.045	−13	225
30	1.032	+3.2	221

TABLE 4—PHYSICAL PROPERTIES OF DOWTHERM

Boiling point		496F
Freezing point		54F
Flash point		228F
Fire Point		246F
Auto-ignition temperature exceeds		932F
Viscosity, centipoises, at:	60F	5
	250F	0.8
	450F	0.4
Specific heat, at:	54F	0.37
	250F	0.47
	450F	0.6
Density, lb per cu ft, at:	54F	66.9
	250F	61.1
	450F	54.8
Heat Content, Btu per (cu ft) (F), at:	54F	24.7
	250F	28.6
	450F	32.8

TABLE 5—PHYSICAL PROPERTIES OF HEAT TRANSFER OILS

Property	S/V Sovaloid S	S/V Heat Transfer Oil
Gravity, API at 60F/60F	10.0	11.0
Specific gravity at 60F/60F	1.0	.9930
Flash point, F, open cup	260 Minimum	355
Pour point, F	—40	10
Viscosity, kinematic centistokes, at:		
450F		.86
300F		1.95
175F	1.7	8.25
100F	3.9	50.00
50F	10.0	450.00
0F	48.0	....
—10F	70.0	....
Coefficient of Expansion, per deg F	.00035	....
Distillation range		
Initial boiling point, F	500 Minimum	615
Final boiling point, F	640 Maximum	735 (90%)
Specific heat, Btu per (lb) (F), at:		
450F	..	.966
300F	..	.910
180F	.47	.864
100F	.43	.835
60F	.42	.820
0F	.39	..

high temperatures, viscosity is extremely thin and the liquid is capable of seeping through what normally would be tight joints. Table 4 shows properties of Dowtherm.

Mineral Oil

Mineral oil can be used freely with all ferrous metals but at higher temperatures it may be affected by catalytic action of copper. The temperature to which oils can be raised is not related to the boiling point but to the cracking temperature of a particular grade of oil. A typical grade of oil has a cracking temperature of 350F, a pour point of 10F, and a flash point, closed, of 390F. The specific heat at 200F is .427 and increases with rising temperature. Stability of oil can be maintained for a number of years, providing air is excluded and the oil is kept below cracking temperature.

A heat transfer oil developed specifically for snow melting systems by Socony-Vacuum Oil Co. is S/V Sovaloid S. Characteristics of the two oils are shown in Table 5.

TABLE 6—PROPERTIES OF TETRA ARYL SILICATES

Viscosity, centipoises, at:	0F	740.00
	50F	52.00
	300F	1.55
	600F	0.43
Specific heat, at:	50F	0.37
	300F	0.48
	600F	0.74
Density, lb per cu ft, at:	50F	72.20
	300F	65.0
	600F	56.2
Heat content, Btu per (cu ft) (F), at:	50F	26.7
	300F	31.1
	600F	41.5

TABLE 7—PROPERTIES OF TETRA CRESYL SILICATE

Boiling point, F	815
Specific gravity, at:	
77F	1.125
392F	.982
572F	.908
Specific heat, Btu per (lb) (F), at:	
77F	.40
392F	.530
572F	.620
Viscosity, centistokes, at:	
77F	41
392F	1.4
Coefficient of expansion, per deg F	.000775 to .000977
Density, lb per cu ft, at 60F	69.3
Flash point, F	325 minimum
Pour point, F	1.0

Tetra Aryl Silicates

This is a group of organic substances having high boiling and low melting points. By chemical combination and mixing of compounds, liquids of a common generic type but having different physical properties are produced within a liquid range of —60 to 800F. The liquids can be handled without difficulty but should be kept away from moisture or an open flame and should not be allowed to remain in contact with the skin. These liquids have an almost negligible effect on iron, steel and copper. Aluminum and its alloys should not be used.

Tetra Cresyl Silicates

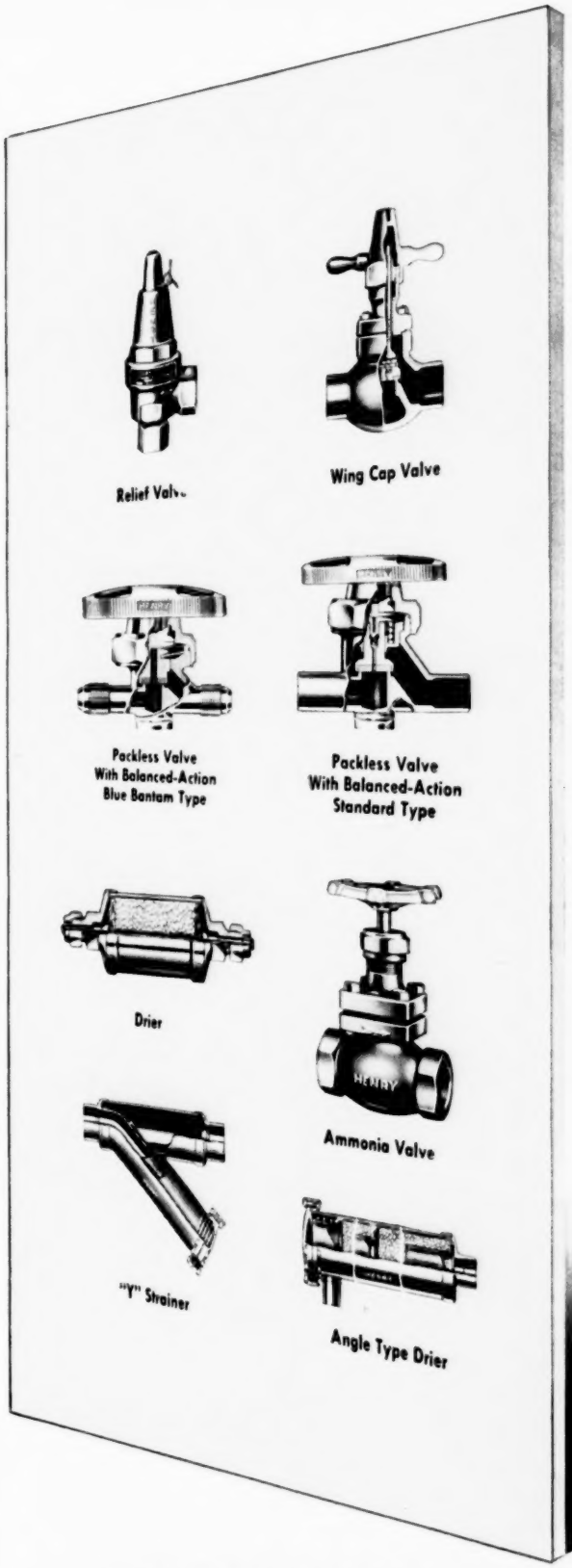
Similar to the aryl silicates is the tetra cresyl silicate family of heat transfer liquids for higher temperature applications. Table 7 gives some of the properties of tetra cresyl silicate.

Mercury

Physical properties of mercury are shown in Table 8. It is the only metal which liquefies at atmospheric temperatures. It can be used with iron and steel but dissolves brass and other metals. Its vapor has a toxic effect. It is stable over the whole temperature range.

TABLE 8—PHYSICAL PROPERTIES OF MERCURY

Boiling point, F		675
Melting point, F		—38
Viscosity, centipoises, at:	—4F	1.85
	68F	1.56
	212F	1.22
	572F	0.93
Specific heat, at:	32F	0.0333
	212F	0.0326
	392F	0.0318
Density, lb per cu ft, at:	32F	845
	212F	830
	392F	816
Heat content, Btu per (cu ft) (F), at:	32F	28.2
	212F	27.0
	392F	25.9



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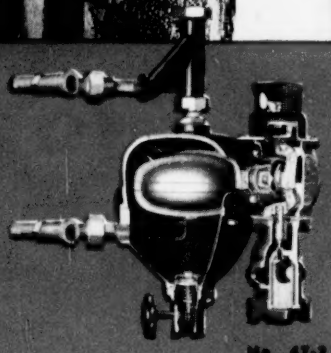

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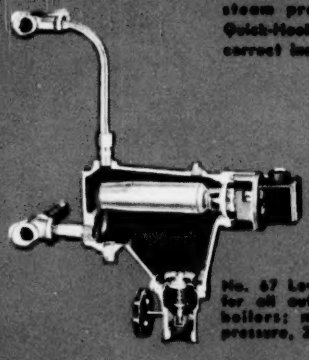

No. 67 Low Water Cut-off for all automatically fired boilers; maximum steam pressure, 20 lbs.

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